WEST VIRGINIA
GEOLOGICAL SURVEY

PLATE I.—Caudy's Castle. (See pages 73-4 for description of plate).

WEST VIRGINIA
GEOLOGICAL SURVEY

Hampshire and Hardy Counties

By

JOHN L. TILTON, Paleontologist,

WILLIAM F. PROUTY, Paleontologist,

R. C. TUCKER, Assistant Geologist,

PAUL H. PRICE, Assistant Geologist.

I. C. WHITE, State Geologist.

1927.

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MORGANTOWN, W. VA.
1927

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INEZ WHITE . . . . *Stenographer*

*Deceased, November 25, 1927.

LETTER OF TRANSMITTAL

To His Excellency, Hon. Howard M. Gore, Governor of West Virginia, and President of the West Virginia Geological Survey Commission:

SIR:

I have the honor to transmit herewith the Detailed County Reports and accompanying topographic and geologic maps covering the areas of the counties of Hampshire and Hardy. Several geologists have cooperated in the production of this volume. Hampshire County was assigned to Dr. John L. Tilton, the paleontologist of the West Virginia Geological Survey with Paul H. Price of the Survey Staff as Dr. Tilton's field assistant, while Hardy County was assigned to Dr. Wm. F. Prouty of the University of North Carolina, with R. C. Tucker of the Survey Staff as his assistant. Both of the assistants, viz, Price and Tucker, took a prominent part in the field work for the counties in question as also the compilation of the reports and maps, these latter having been prepared principally by Mr. Price, while the chapter on Mineral Resources of Hardy County, Appendices, the reading of the proof, editorial arrangement of manuscripts and preparation of Index was the work of Mr. Tucker.

These are two of the very few counties of the State which contain no commercial deposits of coal. In lieu of this, however, they hold vast deposits of limestone, and considerable low-grade iron ores which may become valuable in the distant future when the purer and richer iron ores of the country begin to approach exhaustion.

Both Counties contain much rich agricultural land as also wonderful orchards of peaches, apples, and other fruits.

In this volume as well as that on Grant and Mineral Counties preceding it on adjoining areas, the Survey policy has been to preserve and use the old and well-established nomenclature for the names of the several great rock formations long ago given by the early geologists of New York and Pennsylvania Geological Surveys, rather than the new names like Hampshire, Jennings, Romney, Monterey, etc., which the early workers on the United States Geological Survey attempted unsuccessfully to introduce into West Virginia geological nomenclature. All of the principal rock series early studied and classified in New York and Pennsylvania have been carefully traced southward from their type localities in these two States across Maryland into West Virginia where they have been identified not only by their contained fossils but also by their lithological features which most of them still hold in a very striking degree. Hence, there is every reason why the old names should be retained in accordance with the rules of priority, and the new names discarded from geological literature.

The dividing line between the Silurian and Devonian beds is placed at the top of the Bossardville Limestone, and that between the basal Silurian and Ordovician at the junction of the Gray Medina with the underlying Martinsburg Shales. Dr. Wm. F. Prouty, the eminent geologist and paleontologist of the University of North Carolina, who aided in the preparation of this volume and who also aided Mr. D. B. Reger in the preparation of the volume on Mercer, Monroe, and Summers Counties, was formerly of the opinion that the Ordovician beds should be extended upward to include not only the Gray Medina sandstones as also the Red Medina beds next above, thus making the dividing line between the Silurian and Ordovician sediments the base of the White Medina Sandstone, but from his more recent studies in Pendleton County, West Virginia, and elsewhere, is now convinced that both the Red Medina and the Gray Medina sediments should be included along with the White Medina Sandstone in the basal Silurian beds instead of in the Ordovician, the latter ending with the Martinsburg very fossiliferous sediments.

Moorefield River.

Many years (44) ago the topographers of the United States Geological Survey without any State cooperation made preliminary surveys of several West Virginia quadrangles on a scale of approximately 2 miles to the inch or 1:125,000. One of these quadrangles (Romney) included a large area of Hardy and adjoining counties, and on it the name of "Moorefield River" was given to what in Hardy and Pendleton Counties had always been known as South Fork River. Since no objection to this new name was voiced by the citizens of the two counties this name was retained on the new quadrangles more recently surveyed on a scale of 1:62,500, or approximately 1 mile to the inch, and from these sheets the topographic and geologic maps of Hampshire and Hardy Counties which accompany this volume were prepared, engraved, and printed. When dissatisfaction with this name was brought to the attention of the State Geologist, the question was placed before the National Board on Geographic Names which determines the proper geographic terms. This Board decided that in future maps of the region the name "Moorefield River" would be changed to South Fork River, but this decision came too late to be used on the maps of this Report as they had already been engraved and published but the revised name will be used in the forthcoming Report and maps of Pendleton County. This explanation is made here so that any persons who receive these maps where the name "Moorefield River" occurs, can if they wish, substitute the name South Fork River both on the maps and in the Report.

Very respectfully,

I. C. WHITE, State Geologist.

Morgantown, W. Va., November 15, 1927.

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PART II. HARDY COUNTY.

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Maps I, II, III, and IV in Atlas (Under Separate Cover).

Plates.

Figures.

AUTHORS' PREFACES

Hampshire County.

The field work of this Report occupied the summer of 1923, from the twenty-first of June to the sixteenth of September, John L. Tilton giving his entire time to the work and Mr. Paul H. Price giving his time excepting from the tenth of August to the second of September, during which time he was employed in another county. Dr. Tilton is responsible for the writing and for the sections and map, and Mr. Price is the draftsman who prepared the cross-sections and map for publication.

The writer wishes to acknowledge the careful cooperation of Mr. Price both in the field and in the office, to whose skill and care is due whatever of artistic merit may be found in map and cross-sections. He wishes also to acknowledge the advice of Dr. I. C. White, the State Geologist, whose visit to Romney during the progress of the work brought his wide experience in Pennsylvania and West Virginia to the aid of the field work. He wishes also to acknowledge the kind advice of Mr. David B. Reger, Assistant Geologist, and of Mr. R. C. Tucker, Assistant Geologist in the Survey office, for advice in many ways. To the latter I am also indebted for checking the stream gradients, for editing the manuscript that it may conform to usage in the Reports of the West Virginia Geological Survey, and to the reading of the proof, and the indexing of the volume.

Work of this character would not be possible in one season if it were not for the work of others in adjacent areas. To the north is Maryland with its masterly reports on that region. To the northeast is Morgan County with its report prepared by G. P. Grimsley, and the area of the Pawpaw-Hancock Folio (No. 179) prepared by George W. Stose and C. K. Swartz of the U. S. Geological Survey. To the west is the area of Grant and Mineral Counties, the field work on which has been completed by David B. Reger whose report on that area is at the time of this writing nearing completion. Work to the south in Hardy County was progressing while that in Hampshire County was under way. The area to the east in Virginia has not yet been fully reported upon.

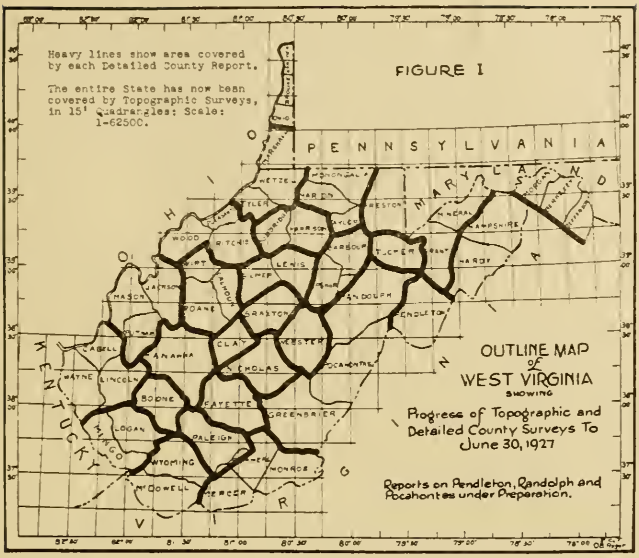

FIGURE 1.—Map showing Progress of Topographic and Detailed County Surveys to June 30, 1927.

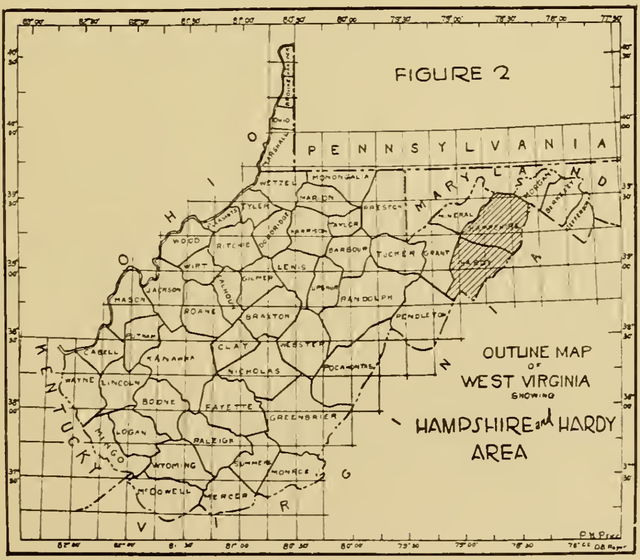

FIGURE 2.—Map showing Location of Hampshire-Hardy County Area.

This report is not a report on paleontology, nor an attempt to add information with reference to divisions between formations. The units already determined upon in the older reports are followed as closely as possible. To aid in this work fossils are of course used, but collections have been made only where such collections were especially needed. It was the plan to work out the details of one cross-section after another, five and a half cross-sections in all, at right angles to the strike and connect in the contacts between. The A—A′ cross-section connects with the work of the Maryland Survey on the north, except for a slight difference in the location of the Catskill-Chemung contact, and the G—G′ cross-section connects with the work in Hardy County on the south. To make the report on the paleontology more complete the list of fossils includes those reported from neighboring regions, as will be explained in the proper place. We are particularly indebted to the Maryland reports on paleontology, which are considered invaluable.

For information on the history of Hampshire County the writer has found three excellent books: James Morton Callahan, "History of West Virginia", three volumes, published by The American Historical Society, Chicago and New York, 1923. For present purposes volume one is the volume needed. James Morton Callahan, "Semi-Centennial History of West Virginia", published by the Tribune Publishing Company Press, Charleston, West Virginia, 1913. Hu Maxwell and H. L. Swisher, "History of Hampshire County, West Virginia", published by A. Brown Boughner, Morgantown, West Virginia. To these interesting volumes the reader is referred for more details than can be here employed. On iron and sandstone much is to be found in Volume IV of the West Virginia Geological Survey. For information on crops and forest trees, Volume V of the West Virginia Geological Survey is found to contain much that is wanted, and for weather records one is, of course, indebted to the reports of the United States Weather Bureau. South Branch has been gaged and the results published in Water-Supply and Irrigation Paper No. 192, the results of which are included in the discussion of water-power. Circular 143 of the U. S. Department of Agriculture discusses the advantages of reservoirs. The Bureau of Census and the West Virginia Legislative Hand Book also afford desired information.

The writer has first endeavored to present general principles in a way that young people as well as others can understand. It is hoped that this portion and what follows will enable all to comprehend somewhat of the structure and beauty of this region. There is one part that it is hard to express without too many words, the kindness and good-will met in all parts of the county. The writer wishes especially to recognize the kindness of Mr. C. N. Loy of Forks of Cacapon and of his brother Peter for the favors received in many ways while engaged in the study of conditions in that remarkable locality.

JOHN L. TILTON.

Morgantown, W. Va.,
July 15, 1924.

Hardy County.

The geological field study of Hardy County was carried on during part of the summer seasons of 1923 and 1924. In this work the writer was assisted by Mr. R. C. Tucker and Mr. Paul H. Price of the West Virginia Geological Survey. In this field work the geological party was at all times composed of two men. During the first field season, the writer had as assistants, first, Mr. Tucker, and later in the season, Mr. Price. During the periods of the association with these two men, most of the western and central portion of the county was mapped geologically and fossil collections were made for faunal studies and formational correlations. A reconnaissance survey was also made of the northeastern part of the county in the Wardensville area.

In the latter part of the 1923 field season, Messrs. Tucker and Price working together nearly completed the mapping of the eastern and southeastern portions of the county.

In the 1924 field season, the writer and Mr. Price again visited the Hardy County area, completed the few unmapped areas, and made additional cross-sections and collections in the eastern and southeastern part of the county.

The field data thus gathered and recorded on field maps by the field parties have been placed on the county map with all necessary interpolations by Mr. Price, who has also constructed cross-sections from the geological map so prepared. In addition to this, Mr. Price and Mr. Tucker have written Chapters VI and VII, and Mr. Tucker wrote Chapter IX on Mineral Resources, prepared Appendix "A" on Levels, and Appendix "B" on Road Material Tests, etc. Mr. Tucker has also had supervision of the publication of the volume, preparing the manuscript for the printer, reading the proof, and indexing the volume.

The geological account (Chapter VIII) of Hardy County has been prepared by the writer. This includes the description of the geological divisions and zones, the life characteristics, and lithology, the thickness, the contacts, and the structural and economic conditions.

The faunal characteristics were studied chiefly by the writer. Dr. J. H. Swartz assisted in the determination of fossils in collections Nos. 2, 3, 4, 6, 7, 15, 16, 20, and 27. For the listing of fossils in collections Nos. 101, 102, 103, and 104, Dr. Swartz is entirely responsible.

The results of the studies on the fossils are recorded by the writer under the general remarks in each formation in the discussion under general geology, and also in the special Chapter on Faunal Relations.

In the preparation of this report the writer is further indebted to Mr. D. B. Reger for a few structural and geological notes along the west and southwest border of the county, and to Dr. I. C. White for general direction in the work.

WM. F. PROUTY.

Chapel Hill, N. Car.,
January 8, 1926.

ERRATA

Page 17, line 23 from bottom, for "Kate", read "Kale".
Page 28, line 16 from bottom, for "Grenspring", read "Greenspring".
Page 32, line 13 from bottom, for "Spring", read "Stream".
Page 35, line 20 from bottom, for "Spring", read "Creek".
Page 50, line 4 from bottom, for "Marcellus", read "Martinsburg".
Page 61, line 16 from bottom, for "Eurypteris", read "Eurypterus".
Page 61, line 15 from bottom, for "Octracoda", read "Ostracoda".
Page 65, line 24 from bottom, for "Rophalonaria", read "Rhopalonaria".
Page 70, line 7 from bottom, for "Conostrophia helderbergiae", read "Chonostrophia helderbergia".
Page 80, line 4 from bottom, for "Stropholosia", read "Strophalosia".
Page 82, line 9 from top, for "Crytina", read "Cyrtina".
Page 82, line 20 from top, for "triquiter" read "triqueter".
Page 83, line 14 from top, for "Ropalonaria", read "Rhopalonaria".
Page 83, line 7 from bottom, for "Crytina", read "Cyrtina".
Page 84, line 18 from top, for "bisculcata", read "bisulcata".
Page 91, line 20 from top, for "vanuxem", read "vanuxemi".
Page 92, line 11 from bottom, for "Cypricardella cumberlandiae Clarke and Swartz 4", read "Cyclonemina crenulistriata Clarke and Swartz 4".
Page 99, bottom line, for "Magaspores", read "Megaspores".
Page 112, line 15 from bottom, for "half a mile south", read "0.9 mile west".

Page 169, line 21 from top, for "**1882**", read "**1832**".
Page 172, line 5 from top, for "**135**", read "**135B**".
Page 179, line 1 from bottom, for "**Henkle**", read "**Henkel**".
Page 208, bottom line, for "**paage**", read "**page**".
Pages 237-8, references to foot-notes on page 238 are on page 237.
Page 247, line 5 from bottom, for "**bads**", read "**beds**".
Page 250, line 24 from top, for "**Ovile**", read "**Olive**".
Page 292, line 2 from top, for "**elongautus**", read "**elongatus**".
Page 292, line 2 from top, for "**rostata**", read "**rostrata**".
Page 292, line 8 from top, for "**suesann**", read "**suessana**".
Page 294, line 18 from top, add comma (,) after ventricosum.
Page 294, after line 28 insert: "**soni, Spirifer cf. tribuarius, Cyrtina close to**".
Page 294, delete line 30 from top (**rostata....15**).
Page 339, line 32 from bottom, for "**criniod**", read "**crinoid**".
Page 340, line 8 from top, for "**an dargillaceous**", read "**and argillaceous**".
Page 366, line 2 from top, for "**RE SOURCES**", read "**RESOURCES**".
Page 378, title Figure 18 set up for 7-inch lines, but printed as 3½-inch lines which accounts for odd division of words at end and beginning of lines.
Page 382, line 10 from top, for "**byy**", read "**by**".
Page 402, line 22 from top, for "**Sprnigs**", read "**Springs**".
Page 413, line 16 from top, for "**ordinarily**", read "**ordinary**".
Page 416, line 19 from top, for "**managnese**", read "**manganese**".
Page 419, line 4 from bottom, for "**46**", read "**45**" (foot-note No.).
Page 423, line 6 from top, for "**Charvoal**", read "**Charcoal**".
Page 433, line 19 from bottom, for "**ni**", read "**in**".
Page 472, line 30 from bottom, for "**Wood**", read "**Wool**".
Page 491, transpose bottom line to line 2 from bottom.
Page 508, transpose bottom line to line 2 from bottom.
Page 550, line 3 from bottom, for "**4515A**", read "**4516A**".
Page 562, line 2 from bottom, for "**ial**", read "**rial**".

CHAPTER I.

HISTORICAL AND INDUSTRIAL DEVELOPMENT.

LOCATION AND RELIEF.

Hampshire County is the fourth county from the east in the "Eastern Panhandle" of West Virginia. It is bounded on the north by Allegany County, Maryland, and Morgan County, West Virginia, on the east by Frederick County, Virginia, on the south by Hardy County, and on the west by Mineral County and a portion of Grant. Of its 630 square miles of mountains and valleys trending N. 30° E., 318 square miles are drained by Cacapon River, 108 square miles by the Little Cacapon, and 180 square miles by South Branch, all tributaries of Potomac River. The remaining 24 square miles are drained directly into the Potomac.

The lowest part of the county is at 520 feet above sea-level, on the Potomac River at the Hampshire-Morgan County corner. Its main valleys lie between that level and 726 feet above sea-level for the valley of South Branch, and 1034 feet for the valley of Cacapon River. The mountains rise to 2500 feet at Cacapon Mountain, 2610 at High Knob, Mill Creek Mountain, and 2870 at "Pinnacle", North Mountain. Thus the maximum relief of the county is 2350 feet.

The main line of the Baltimore and Ohio Railroad passes through the northern margin of the county, and north, across the North Branch of Potomac River, are the Chesapeake and Ohio Canal and the Western Maryland Railroad. A branch of the Baltimore and Ohio Railroad extends northeast-southwest through the county from Greenspring through Romney to Moorefield and Petersburg farther south.

The magnetic declination at Pawpaw in 1923 was 3° 3.4′ west.

SETTLEMENT AND EARLY GROWTH.

Hampshire County was a part of the land grant issued to Lord Fairfax in 1691 and later surveyed by George Washington in 1747-1748. The first settlement was in 1735 at the mouth of South Branch. As the existence of open country along the river was soon made known, settlers pushed up the valley to locate their homes. The region as a whole became Hampshire County in 1754 and remained so until after the French and Indian War, which closed in 1761.

During the troublesome times of that war, Hampshire County was a frontier region with its lines of travel protected by forts. Fort Cox at the mouth of Little Cacapon guarded the road along the Potomac and the trail up the valley of the Little Cacapon. Fort Capon at the Forks of Cacapon guarded what remained of the settlement at the east end of Bloomery Gap and the road toward the important colonial town of Winchester. Fort Edward at Capon Bridge guarded another line of communication with that same town. Fort Pearsall, half a mile south of where Romney was located, guarded an important line of travel that had previously developed along South Branch, south toward what is now Hardy and Pendleton Counties and farther west. Each fort thus located also served as a rallying point in case of need. The area had not been subject to Indian attack prior to that time, but during the French and Indian War, the Indians were a constant menace, and in 1755 to 1758 invaded Hampshire County and killed settlers as far east as near the Forks of Cacapon. During that time Hampshire County was essentially depopulated, the only families remaining being under the protection of Fort Edward at Capon Bridge and of Fort Pearsall (near Romney).

In 1762, the year following the close of the French and Indian War, Lord Fairfax established Romney a little to the north of Fort Pearsall. The population of the county continued to increase through the time of the Revolution until in 1782 it was able to furnish a company of militia to aid in guarding the settlers in the valley of Cheat River from invasion by the Indians.

The influx of settlers at the close of the Revolution was so pronounced that in 1786 Hardy County was set off as a separate county, and likewise Pendleton in 1788. In 1795, the date of Wayne's treaty of peace with the Indians, a great movement of settlers toward the West began to which the entire valley of South Branch contributed. Here within the county the movement was south toward Greenbrier and west toward Clarksburg and Parkersburg.

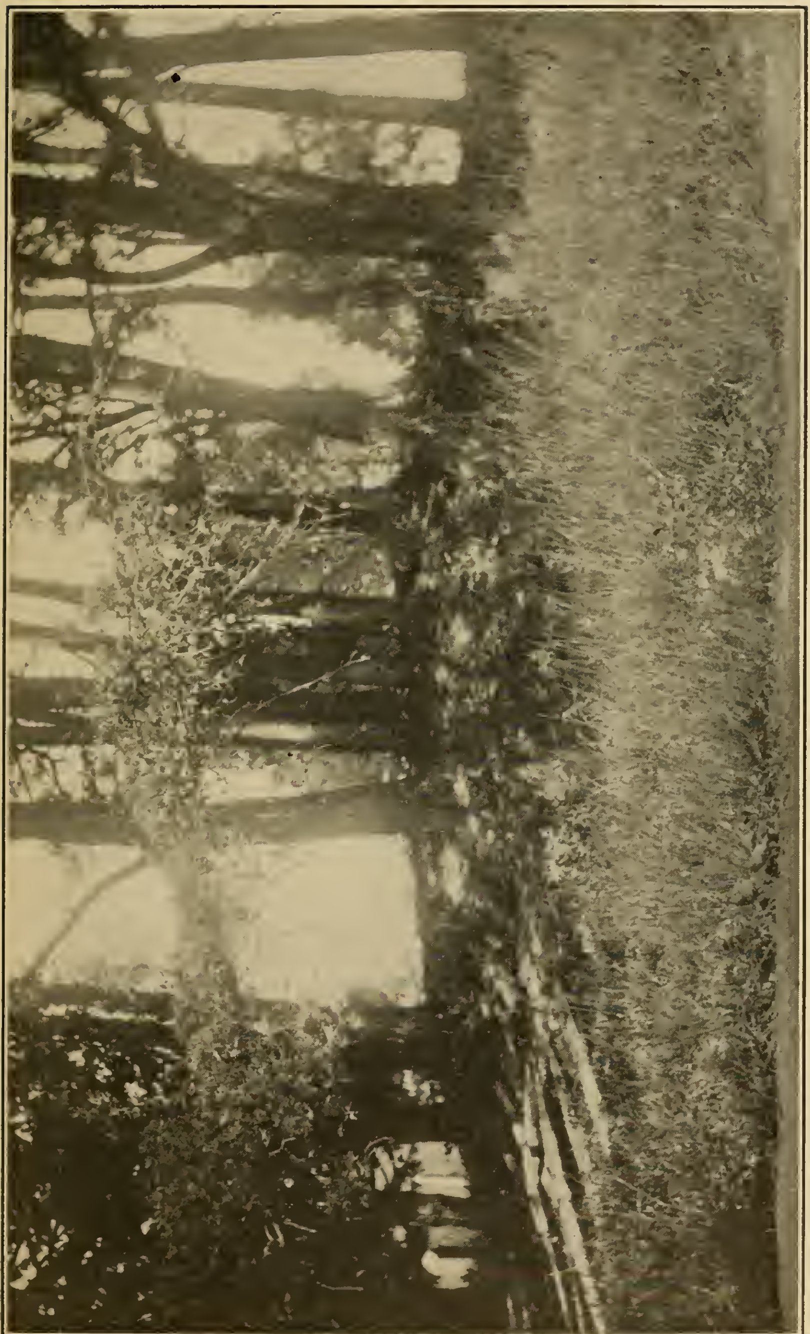

PLATE II.—Indian Mound, Romney, W. Va., looking north.

Morgan County remained a part of Hampshire County during all the early years of development until 1820. Mineral and Grant were parts of Hampshire County until after the Civil War, when in 1866 they were set off as separate counties.

LINES OF TRAVEL.

The development of emigration westward along the Potomac toward the Ohio, and along the James to the Kanawha, was accompanied by a movement westward from Winchester, resulting in a State road in 1786 from Winchester via Capon Bridge and Hanging Rock Gap to Romney, where stage lines from Greenspring on the north and Moorefield on the south soon centered and a line went west via Mechanicsburg and Burlington to Cumberland in 1830. By 1845 a stage line ran from Romney to Morgantown and to Clarksburg and then to Parkersburg. Even before that time the National Road from Baltimore to Cumberland was extended from Cumberland to Wheeling and in 1818 opened for travel.

The construction of the Chesapeake and Ohio Canal for the transportation of freight, which canal passes close to the northern border of Hampshire County, did not progress so rapidly. It was not completed until 1850. Up to 1830 flatboats went down South Branch with flour and iron for Washington and Alexandria.

In 1801 plans were begun for a road from Romney through Berkeley County. In 1842 the Baltimore and Ohio Railroad was completed from Baltimore to Cumberland, passing through Greenspring, and later extended to the Ohio. The branch from Greenspring to Romney was not completed until 1884. It was extended to Petersburg in 1910.

Much of the good-roads work so important locally and so well begun came to a halt during the Civil War, when nearly every bridge in the county was destroyed. In recent years the use of the automobile has again aroused our citizens to the need of good roads, and the work of improvement is progressing rapidly.

EARLY PRODUCTIONS.

The wide lowlands of Hampshire County certainly invited agriculture, and fields of wheat and tobacco surrounded the important truck-patch of the settler. The rolling uplands offered pasturage for horses, cattle, sheep, and hogs, which were driven across country to market at Winchester. The streams abounded in fish and the mountains contained not only game but timber and stone for the early settler's home.

The limestone was burned for lime at Bloomery Gap, where remains of old lime-kilns give evidence of an early industry. Soon it was discovered that some of the strata contained iron ore. Much of it was transported to Keyser, from an area along South Branch south of the present limits of the county. In Bloomery Gap a ruined furnace still stands, mute evidence of another former industry. In the early days the increasing population stimulated not only farming and grazing but every industry of a new country. James Morton Callahan, in his "History of West Virginia", Volume I, page 135, tells us of these early industries as follows:

> "In 1800, Robert Sherrard built at Bloomery a large stone-mill and also a woolen-mill. William Fox built a merchant mill at Fox's Hollow in 1818, and shipped flour by boat to Georgetown. Hammock Mills, flour and woolen, was another very early plant. Also the Painter mill was a pioneer establishment on North River about a century ago. Colonel Fox established a tannery in 1818 in Fox's Hollow, which was operated until the Civil War. Another tan-yard was on Dillons Run, and Samuel Gard had another extensive tannery at Capon Bridge prior to 1820. New methods came in and the leather trade in this State had to succumb to the advance of this industry and improved machinery. Distilleries were located at many points in the county."

Of the iron industry at Bloomery Gap he also says:

> "The Bloomery furnaces, ruins of which are still to be seen, were built and operated by a Mr. Priestly and were being run in 1833. Large quantities of iron were made and shipped over the Cacapon River on rafts and flatboats. S. A. Pancoast purchased the furnaces in 1848, and after his death they continued in other hands until 1875."

At the present time the property is under the care of Webster H. Wyand, of Hagerstown, Maryland.

EARLY CHURCHES.

Not only in a material way were the people of the county developing wealth but in an even more important way did they continue to advance. The early missionaries helped to sustain the religious faith of the early inhabitants. In 1775 two Baptist missionaries among a group of settlers moved to Cacapon and organized the first church in the county. In 1771 the work of the Methodist Episcopal Church was begun, in which later developments led to the formation of the Methodist Episcopal Church South. In 1753 Hampshire County had been formed into a parish by the Protestant Episcopal Church and in 1773 a missionary sent by that church began work. In 1787 a Primitive Baptist Church was established at North River. Soon after the Revolution there was preaching by the Presbyterians at different points in the county. In 1792 a Presbyterian Church was organized at Romney and another at Three Churches.

EARLY SCHOOLS.

In those early days the opportunities for schooling were entirely in "subscription" schools. In 1810 a literary fund was established to assist those who could not afford their share in the subscription. In 1845 school districts were established and soon provisions made for district schools for the white children, provided two-thirds of the voters would vote the additional levy. It was against the law to teach a negro to read. When the Legislature of the new State of West Virginia met in 1863 it laid the foundation for free public schools that from meager beginnings has evolved into the present plan of public schools.

At Romney there had been better facilities for a common school education than in the county generally. The oldest schoolhouse in the county was known as Romney Academy, which continued in use until perhaps 1845 when the Romney Classical Institute was built under the influence of the Romney Literary Society, and, excepting during the war, continued in use until it became the property of the new State School for the Deaf, Dumb, and Blind, established in 1870, now an honor to any State. Near 1851 there was a second school, a seminary, at Romney, and at Springfield there was an academy from 1854 to 1861.

DESCRIPTION OF PLATE III.—In 1870 the town of Romney donated the Romney Classical Institute to the State to be used as a school for the deaf and dumb. To this building the State added five wings, and in 1898 built an additional school building near at hand. The State now owns 176 acres. In the School for the Deaf there are now 143 boys and 110 girls.

DESCRIPTION OF PLATE IV.—The present School for the Blind lies a few hundred yards west of north from the School for the Deaf and Dumb. The central building was the old Potomac Academy, purchased by the State in 1919. The wing added to the right is the dormitory for boys, and the wing upon the left is the dormitory for girls, all steam-heated. There are now 50 boys and 27 girls in the institution.

In the distance, across South Branch of the Potomac, rises Mill Creek Mountain, its curved slope marked by long rows of trees in peach orchards, and by rectangular areas of plowed ground. The resisting rock in the ridge is Oriskany Sandstone, a portion of which, very calcareous, supplies the lime needed in the crops.

THE CIVIL WAR.

In 1860 Hampshire County had a population of 12,481 white and 1,213 colored, and the sympathies of the people were largely with the South. All advances in prosperity received a severe check as the Civil War came on. The early events in the western part of what was then Virginia culminating at Cheat Mountain made it clear to General Lee that

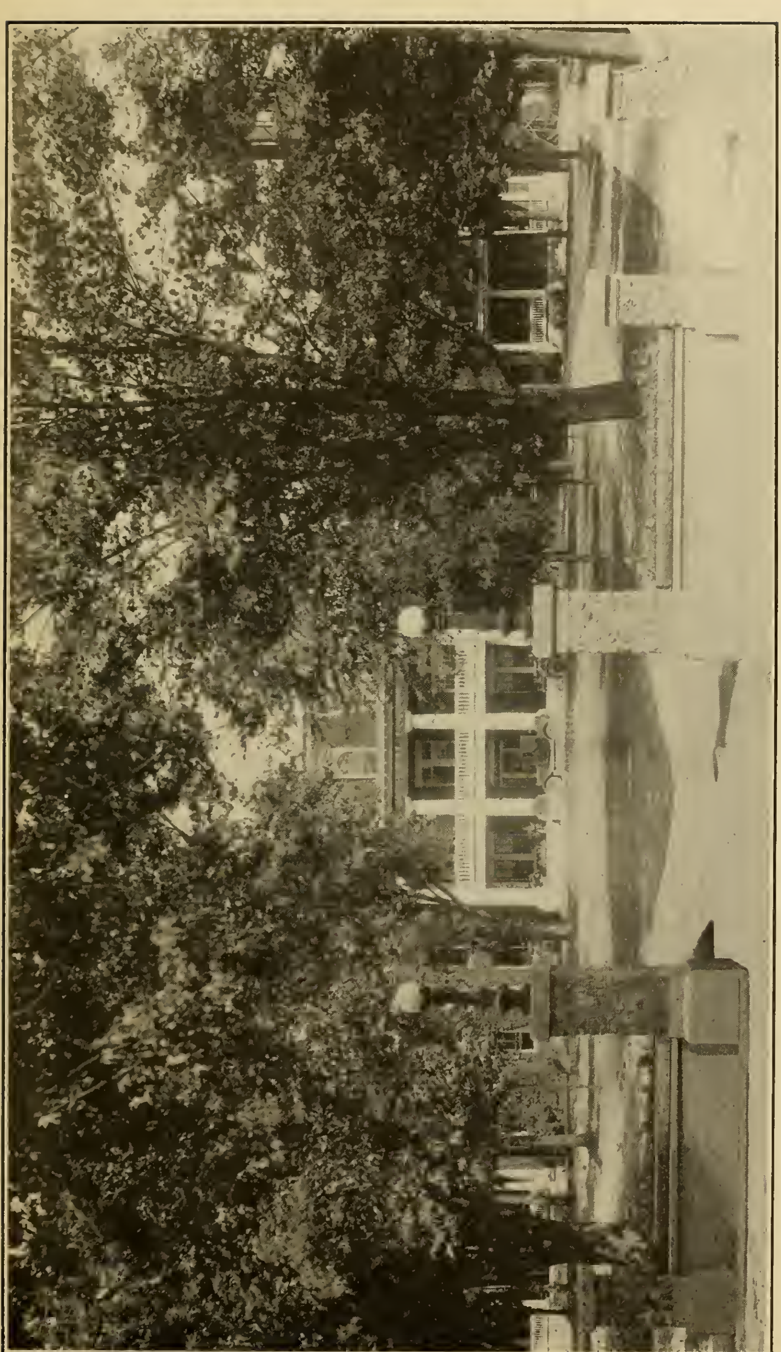

PLATE III.—School for the Deaf and Dumb, Romney, W. Va. (See page 6 for description of plate).

PLATE IV.—School for the Blind, Romney, W. Va. (See page 6 for description of plate).

the lines of the Baltimore and Ohio Railroad in western Virginia and that the Kanawha Valley could not be held without sending large armies to those regions, where they would have to operate at a distance from their base of supplies. He retired east of the Blue Ridge but endeavored to maintain control of the Shenandoah Valley. This gave him a short inner line of communication in the critical area, but it placed most of Hampshire County between his main area of operation and the line of the Baltimore and Ohio Railroad through the northern edge of the county. This line remained in the possession of the Federal troops most of the time from the fall of Harpers Ferry in May, 1861, to the close of the war, though subject to attack, and cut by the Confederate Army at times, as on the advances that led to Antietam and to Gettysburg. For a while the local Confederate Army had its center of operation south of Moorefield, from which place there was communication along the old stage route with Winchester. Repeated advances northward past Romney, and counter advances of Federal troops whose headquarters were at Keyser and Cumberland led to a change of occupation of Romney at least fifty-six times. The early stage routes along the valleys became routes of opposing movements, the narrow passes and mountain trails offered ready concealment for rangers, and the roads eastward past Capon Bridge and Bloomery Gap were lines that each army had to control during its movement along the Shenandoah Valley just east of Hampshire County. As a result of this prolonged exposure Hampshire County began its new era following the war with nearly all its bridges broken down, its highways out of repair, its fields uncultivated, its property damaged, and, most of all, a depletion in population of the manhood so much needed. But under the new conditions the population rallied to the work of repair. Again the fields were cultivated, again the wealth of forest sought, and the streams restocked with fish. The latest types of agricultural implements have been introduced, the use of fertilizers employed to prevent the depletion of the soil, and advantage taken of the fine conditions for fruit, especially peaches and apples, and mutual helpfulness inaugurated in agricultural societies. Under the fruits of such energy the county has rapidly recovered. It bore its part in the World War, and now looks forward to renewed prosperity.

CHAPTER II.

GEOLOGIC PROCESSES.

FIRST PRINCIPLES IN GEOLOGY.

It is to be hoped that in Hampshire County many of the young people, and possibly others not acquainted with the principles of geology, will be interested in this Report and begin active inquiry into the rocks of their native county. To assist such, a chapter is here inserted on first principles of geologic processes. Some of them are simple, easy to be comprehended. Others that are more complex the writer will not here dwell upon.

The first principle may be illustrated by a simple experiment. Throw a large handful of gravel, sand, and soil out on the ground. It falls as a mass without separating into layers. Now take a large handful of the same gravel, sand, and soil and throw it into a deep glass jar, preferably one that is fifteen inches or so high, filled with water. The gravel goes to the bottom instantly, then follows the sand, then the finer material of the soil, the finest material of all settling very slowly as a fine sand or mud. Now throw in a second large handful and watch the process again as the gravel, sand, and soil settle to the bottom. What you see in the jar is stratification—the material is stratified. The largest fragments were pulled through the water first, then came the medium-sized particles whose larger surface per ounce or gram encountered more resistance. A sorting of material like this is not dependent upon time or place where the experiment is performed. You can perform it in Washington, Florida, California, or China and the result will be the same. The same result could have been obtained by Columbus, by Aristotle, by Cyrus, or by any other ancient worthy. We will not here attempt to distinguish between stratification (lamination) by wind and lamination of fine mud by water, nor stop to consider the peculiar stratification of lava flows. It is sufficient for our present purposes to see stratification by water.

Now let us vary the experiment slightly. Put into the glass jar some pieces of snail shell or clam shell, and in the next handful of gravel, sand and soil have some fragments of water-soaked rotten wood, or of river plant remains. Throw all of these into the jar above the shells. Now note that the shells are in a position that shows they came to rest on the bottom before the last handful was thrown in, and that the fragments of water-soaked wood thrown in are either entangled in the mud or are separated so as to make somewhat of a layer. In terms of age the shells and the wood reached their places of rest after the earlier deposition and before any later depositions of gravel, sand, and soil that you may choose to throw into the jar. This experiment, like the first, is independent of the place where it is performed, and of the time when it was performed.

Now let us take our stand by some puddle by the roadside and watch to see what becomes of the mud washed in there while it is raining, or immediately thereafter. The coarser material forms a sort of embankment close to the mouth of each stream entering this little lake. Finer material rolls over and over until it comes to rest out farther from the mouth of the little stream. Farther out yet the water is cloudy with the fine mud that has not yet settled. This is our glass-jar experiment over again, only the water has been in motion and has deposited some of the material at a distance from the gravel. As the water ceases to flow some of the fine material then begins to settle down on the gravel, as in the jar.

Now drain this little lake and seek others that are drained, cut carefully through the material deposited and note the stratification. Next let us follow up some of these little gullies and see where the material comes from. The fresh gullies are there, and if the water is still abundant we may see the heads of some of the gullies still advancing up into the slopes.

Now we are ready to take a look at some of the deposits of other times in the neighborhood, choosing first a place where men have obtained dark flakes and chunks for road-making. This we find to be in layers and the material like mud—shale we will call it—and in the shale itself and in the partings in the shale we may be able to find the shells laid there or covered up there as the layers (strata) were being laid down. Here is the glass-jar experiment of a former time.

Visit other kinds of rocks and learn to distinguish sandstone by the presence of the little rounded grains of sand that are cemented together into a solid rock. If possible find a bed of limestone and look for fragments of shells in it. Some shells are too small to be seen readily without a magnifying glass, and other forms are weathered out, some of them suggesting something like sponges lying upon the ground, forms of life that had been concealed by the sediment. Everywhere material is weathering at the surface, the material thus loosened washed into the streams, and thence carried toward the ocean, though the particles may tarry a long time on the way.

The material we saw forming was laid down flat, especially so where the water was quiet. In the hillsides we find some places where the layers (strata) are horizontal, then we come to places where the strata bend down. Let us follow them along the road. If the strata bend down other strata above come into view, and then others, until very soon we come to a place where the strata are flat, and then to where they begin to slope (dip) the other way. Stratum after stratum comes into view in reverse order until strata like those we first saw come to the surface again. Here is where the use of shells (fossils) comes in, for they help us to recognize the strata. We have just passed a place where the strata bent down into the ground (a syncline) and then came up. Now let us follow the strata along farther. Other strata below what we first noted come to light and rise into the air. Most of them seem to stop at the surface of the ground, and some of them that are very hard rise up into the hills. After a while, however, the strata that are coming up are nearly flat, and then begin to dip in the opposite direction into the ground again. Here is the crest of an arch (an anticline). Following along farther, the strata that seemed to stop at the surface are coming down again, until strata like the first ones that we saw, fossils and all, are before us. We have thus passed an arch (an anticline) the top of which has been weathered and washed away down to the present hills, so that the strata seem to end at the surface where the wearing away (erosion) is still in progress.

These strata were in a horizontal position when first laid down. Every detail in them, from the position of the pebbles and shells to the extent of the resistant beds, tells us this. And again in a language that is unmistakable they tell us that after the strata were laid down they were compressed until they were bent into great folds; and the processes that we see in progress tell us what happens to the parts that bend up where the processes of erosion get at them. By tracing the curves as the strata rise into the air and by varying the curves to fit variations in the dip of the strata remaining as yet uneroded in the ground, one traces the

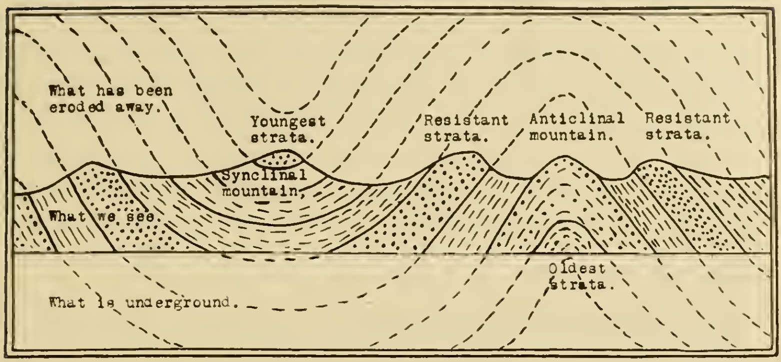

Figure 3.—What we see in the hillside, what we infer is in the ground, and what the processes observed lead us to infer has been eroded away.

outline of the arch eroded away. There are often well records of what is in the ground by which one can trace a stratum underground. This is especially true where there is much boring for oil and gas, as farther west in the State. But even without well records one traces the strata underground by the aid of the variations in dip at the surface above.

There remains one term to be illustrated. That term is **strike.** If a book is placed with its edge on the table and then made to incline to one side, the direction of dip will be the direction of steepest slope down the cover. At right angles to this direction a hand-level would show a horizontal line, which line is the **strike.** The direction of the strike is measured from the north (sometimes from the south) as North so many degrees East (or West). The dip is measured as an angle from a horizontal line directly above.

There is thus nothing abstruse in the principles involved. The facts fit together as nicely as 2 and 4 added together make 6, and 3 added to 6 make 9. Expressed as geological principles we may say, strata deposited horizontally in successive intervals of time, and horizontal pressure applied after the strata were deposited, added, give us folded strata. Folded strata and erosion give us a varied landscape. Such principles can be recognized and it is hoped followed by all, but to develop the subject from the field data one must first learn to recognize the different kinds of rocks, learn to recognize the fossils, and learn how to use them, and study the details of the various processes of sedimentation and the forms of erosion.

In what follows it is hoped there is sufficient of detail, but not an excess, so that one who wishes to follow the presentation can do so without difficulty, and find what will enable him to see the application to his own immediate neighborhood. It will be the business of our State Survey to answer questions that may arise, especially questions of an economic nature.

The various kinds of rocks, the conditions of their formation, the changes to which they have been subjected, their value for different purposes, underlie all agriculture and other industry; and an appreciative study of them is vital to the intelligence of a community.

GENERAL STRUCTURE AND TOPOGRAPHY.

The county is divided into three general regions, a southeastern part of parallel ranges of mountains, drained by the Great Cacapon and its tributaries, a northwestern part, drained by the South Branch of the Potomac, and an area between, drained by the Little Cacapon. A cursory glance at the lay of the rocks reveals mountain ranges of resistant materials, all with strike N. 30° E., and valleys along less resistant rocks. A further study of the changes in dip leads to the recognition of anticlines and synclines. Cacapon and North Mountains are anticlines, in the arches of whose strata the deepest and oldest strata in the county are exposed to view, protected by the White Medina Sandstone and Conglomerate whose masses of quartz though yielding slowly still defy the elements. These massive ledges disappear beneath the ground toward the northwest not to appear again within the limits of the county. These strata may be seen rising above the surface again in all their grandeur near Cumberland, Maryland.

Above the White Medina other strata came into view toward the northwest involved in minor folds. Thus the county as a whole consists of one great syncline (geosyncline) with numerous anticlines and synclines impressed upon it. West of Cacapon, where erosion encounters resistant strata, the ridges and ranges reach up into the air. A very resistant sandstone known as the Oriskany (Ridgeley) Sandstone maintains the crest of Little Mountain, from which it dips steeply to the northwest and does not appear again at the surface until it rises to form the crests of River and Valley Mountains east of Greenspring. Southwest of Cacapon the Oriskany Sandstone is often at the surface, standing up in numerous ranges that rise into the air and then curve down beneath the surface, to appear again above ground in another arch a little way off to one side (en echelon). Such mountains are Bear Garden, Dillon Mountain, Schaffenaker Mountain, Cooper Mountain, Ice Mountain, and North River Mountain. So, too, the ranges of Oriskany Sandstone are continued southwest of Valley Mountain by Mill Creek Mountain, beyond which to the northwest they disappear into the ground, to appear again in the mountains near Keyser.

In the broad synclinal area between these two belts of Oriskany ranges, the ridges of other resistant strata come to view. The Rockwell and Purslane are two resistant groups of sandstone and quartzite that form the crests of Sideling Hill Mountain, Spring Gap Mountain, and both of the two crests of Short Mountain. Elsewhere ridges of Chemung strata are noticeable where resistant strata of that group are at the surface. This is particularly noticeable where the Hendricks Sandstone and Conglomerate, the topmost member of the Chemung, is at the surface. Such resistant strata protect less resistant strata as long as the resistant strata last, but once gone over a considerable area the shales exposed yield to the attack of the elements and the area gradually becomes reduced to that of a lowland, narrow where the beds dip steeply, as in the mountainous southeastern part of the county, broader where no very resistant strata beneath are brought to light, as along the South Branch of the Potomac.

These various anticlines and synclines, all with strike N. 30° E., present what is called a folded structure. In this structure the main drainage lines are here developed along the broadest areas of shale. In the mountains the streams flow in the direction of the strike for considerable distances, and then cut across from one valley to the next where one fold with resistant strata plunges into the ground and another begins to rise. Thus the structure controls the location of the streams, but the whole story is not so simple as that, for some of the streams have cut across from one valley to the next where the lowest part of the structure does not now exist. That is to be found a little to one side of the present location of the stream. This is nicely brought out at The Rocks and at Grace. Yet, as rivers aid in the process of making the valleys, scouring downward or sideways, transporting the material thus gathered, and other material washed in by the tributaries, it must be that at some former time these transverse courses were developed at points where it was then the lowest, and that since then the stream has continued to trench its valley at these points.

All of the drainage pours into the Potomac, the "master stream" of this region, which has been able to maintain its

PLATE V.—View southwest from the Terrace at Indian Mound Cemetery, Romney, W. Va. (See page 17 for description of plate).

DESCRIPTION OF PLATE V.—View southwest from the terrace at Indian Mound Cemetery at Romney. The central low ground is the flood-plain along the South Branch, to the right of which rises Mill Creek Mountain. To the left of the flood-plain is a long wooded terrace rising to the level of Indian Mound Cemetery from which the view is taken. The first terrace which lies between this terrace and the flood-plain is not here distinctly differentiated from the flood-plain but it appears in the immediate foreground, and in the middle ground a dam is located upon it. In the background and a little to the left of the center the distant peak is High Knob just south of the Hampshire-Hardy County line.

drainage line to the sea, cutting through barriers encountered in the changes of elevation that occurred. Thus the drainage area of the county is but a part of a greater drainage area of the master stream of the region, the Potomac.

Even with these variations still we must admit that the structure has controlled the development of the drainage plan. There are some remarkable illustrations of this in addition to what have already been cited. A most remarkable case is that of the South Branch of the Potomac where it flows along the axis of a very compressed syncline as straight as a river can flow, through "The Trough" between Sawmill Ridge and River Ridge for a distance of six miles. Kate Hollow, Gunbarrel Hollow, and Dillons Run are all valleys whose straight courses dependent on structure suggest the meaning of the second name. Meadow Run flows straight southwest along an eroded syncline, hemmed in by the rising walls of Purslane that have not as yet been eroded.

In the region as a whole a folding occurred long after the strata were laid down, for all are involved in the folding. The Potomac occupies the line of drainage that has been maintained across these folds, but the present drainage of the county, whatever its original plan, has been developed into its present plan since the folding occurred. Where the axes of synclines contained soft strata drainage lines have been established. The crest of an anticline is even more favorable to erosion than the axis of a syncline, for the strata as they were bent up are more quickly exposed to weathering and are cracked open in the folding. A set of joints runs parallel to the strike, and other sets run approximately at right angles to these. In a synclinal area the strata were packed together in the folding. Thus the presence of anticlinal valleys is readily explained, but extensive synclinal valleys could only become developed under changing conditions where the level of resistant strata happened to be right for the maintenance of the valleys. Gunbarrel Hollow is certainly remarkable as a synclinal valley, but "The Trough" above Romney is a topographic feature seldom duplicated.

Thus we must look to the structure for the general plan of the topography. Parallel folds and ridges of resistant strata make the mountains, eroded shale in a broad complex synclinal region determines the location of the main drainage lines, and the **en echelon** character of the folding determines cross erosion lines, giving a trellis type of drainage. In this trellis plan three rivers serve as the main drainage lines through which the water flows to the Potomac. These three rivers are the Cacapon on the east, South Branch of the Potomac on the west, and Little Cacapon River between the two. Into these main drainage lines numerous runs with steep branches are developed, leading the rainfall from all the mountain slopes and the valleys between. The Cacapon has North River as its chief tributary, and Bloomery Run, Mill Branch, Edwards Run, and Dillons Run as minor tributaries. North River also has two minor tributaries of rather large size: Crooked Run and Bearwallow. South Branch has a large tributary in Mill Creek and a minor tributary in Big Run.

HISTORY OF THE TOPOGRAPHY.

What the Rivers are Now Doing.—Stand on a bridge, as at Capon Bridge, Forks of Cacapon, South Branch near Romney, or at Grace, and watch what the water is doing. Apparently nothing but flow swiftly away over green-covered rocks, or more slowly over deeper-lying sands. Yet even these clear waters, so attractive to the fisherman, are constantly bearing away to the Potomac and thence to the sea an amount of unseen material in solution, that, day by day, year in and year out, is a surprising amount. Much of this comes from the limestone areas along which the waters have dissolved out underground channels. In some places these underground streams come out as large springs where the clear water spreading out over the ground evaporates leaving in the course of time an abundant deposit of lime (travertine). Such is the thick deposit that has formed at a large spring on the west side of Cacapon River about half a mile south of Castle Rock. Another such location is along the north slope of Slanes Knob, where the water from limestone farther up in the mountain evaporates as it oozes along the slope at the foot of the mountain on its way to Cold Stream.

If now a heavy rain occurs the clear waters of the rivers at once change in appearance. Fine material, loosened everywhere in the processes of weathering, is caught up by the water rushing down the mountainsides and out through the valleys until the swollen streams are yellow with the sediment they carry; and the streams boil over their rocky beds, swirl against yielding banks, and gather up loosened material along the cliffs. Stones that the more quiet waters could not move are now jostling against each other and grinding against the foot of ledges. The volume of the material that the rivers carry is now impressive, and much of the material that is carried along is from the best soil of the higher ground. As the water goes down after the rain, sediment is left as a rich deposit over low ground, but to the mountainside field it is a loss forever, to be slowly replaced over and over again by weathering of the rocks that are left. The soluble material and the fine sediment get to the rivers, but much of the coarse material rounded in its rough journey down the steep gullies, stops awhile along the foot of the slope until further weathering and wearing reduce them to a size that rain or some encroaching stream can gather into its waters.

Such action has been going on for unknown centuries. The oldest trees have entwined their roots around rocks that seem to have tumbled there but yesterday; but the oldest trees have lived too short a time to serve as a unit to measure time. The process itself writes its own history as the rivers sink their trenches, then widen their valleys until they begin to wind around (meander) upon their deposits laid down at one time and awaiting favorable conditions on which they will again be gathered into the stream and carried farther to the ocean. On the mountainsides the hardest rocks are gradually yielding to the various processes of weathering. As this natural sandpapering-like process goes on, the streams, rolling the fragments along, are engraving the mountains and hills with ever-deepening ravines and valleys, but never cutting below the levels of the master streams. It is clear that with time enough this process continued unchanged would give us wide valleys with streams whose gradients are fully adjusted.

The lowest level is determined by the master stream, from which the tributary valleys slope back up to the headwaters; and give us an area reduced until the streams flow

DESCRIPTION OF PLATE VI.—View west from the west side of Cooper Mountain through Hanging Rock Gap. The valley of North Fork of Cacapon River lies just beyond the gap. In the left background beyond the valley lies Stony Mountain south of Shanks. In the distance on the right are the high grounds east of Romney.

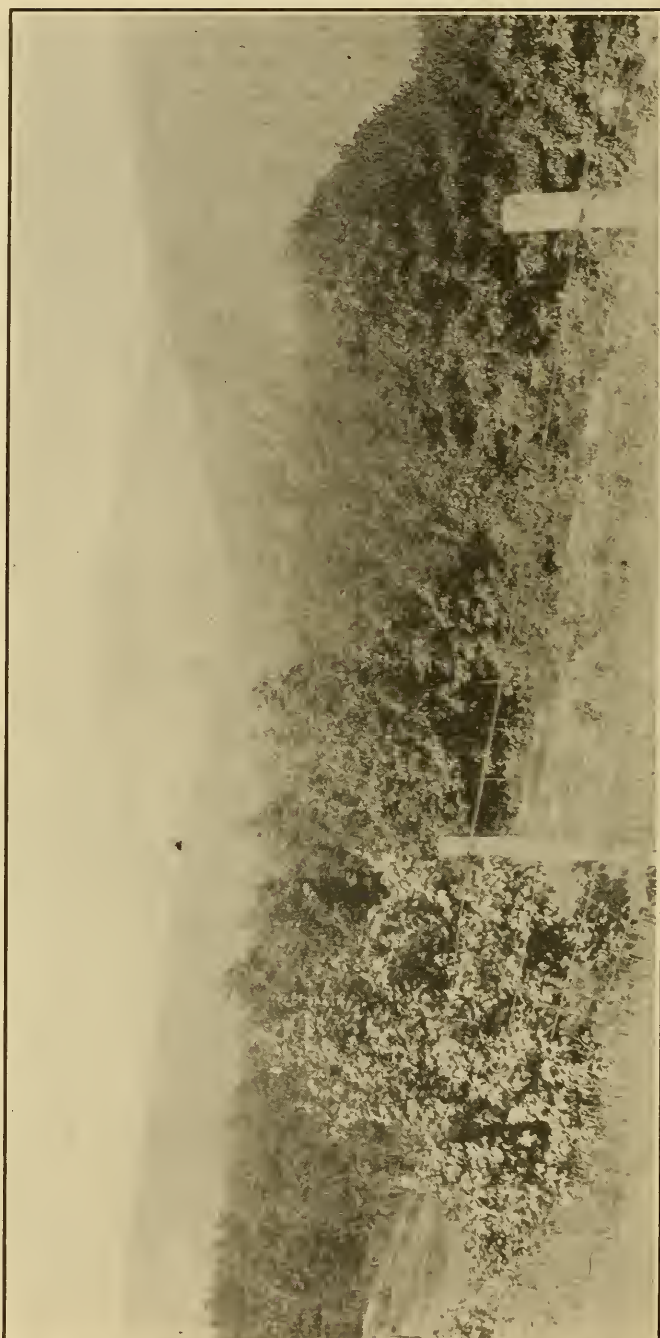

PLATE VI.—View west from the west side of Cooper Mountain through Hanging Rock Gap. (See page 19 for description of plate).

too slowly for active cutting, and the weathered material mantles the gentle slopes where high ground had once stood. This we may call a completed cycle. It is further evident that if this gradual change toward "old age" in topography were interfered with by a bending down of the region this area would become an area of deposition; and that if this gradual change toward old age were interfered with by a general uplift of the region the streams would begin to flow more swiftly than before and begin to cut down their trenches below the level of their flat flood-plains on which as sluggish streams they had meandered. In other terms, we should have entrenched meanders in a region more or less base-leveled, and a peneplain extending out from the rivers in a manner dependent on the degree to which the cycle of erosion had been carried to completeness. The same would follow if the master stream, held back by a barrier, were to succeed in cutting through the barrier, thus permitting the master stream to trench its valley above the obstruction.

Having noted the present process of river action, let us now look to see what evidences there are of former cycles.

Stream Gradients.—The flood-plains of the present streams are not very wide and the streams themselves are somewhat held back by resistant strata that they cross. This is more noticeable in the higher reaches of the tributaries, for the streams have developed the main valleys in areas of least resistant rock (shale). West of Rio, waters of North River fall 200 feet in three and a half miles, then 100 feet in 2.2 miles past Rio as the stream crosses the structure of the rock. Farther on it flows chiefly over shale, so that to the Forks of Cacapon the fall is 400 feet in 35.3 miles, averaging 11.33 feet per mile.

The Cacapon River from the Hampshire-Hardy County line to near Castle Rock falls 216 feet fairly uniformly, 8.1 feet per mile for the entire distance of 26.65 miles. At this point the stream crosses resistant strata that are dipping steeply to the northwest, checking the downward cutting

DESCRIPTION OF PLATE VII.—A view northeast down the valley of South Branch of Potomac River, from Nelson or Roland Lambert Mill three-fourths of a mile east of Raven Rock. In the immediate foreground Oriskany Standstone dips steeply from River Mountain to beneath the river bed. In South Branch Mountain to the right (locally called Jersey Mountain) are Chemung and Catskill strata. In the foreground across the river is the low terrace which is occasionally covered in the most severe floods. The flood-plain proper is the low ground the surface of which is about half-way between the level of the river and that of the low terrace. In the background is a low ridge of shale the top of which corresponds in level to that of the higher terrace on which Romney is located.

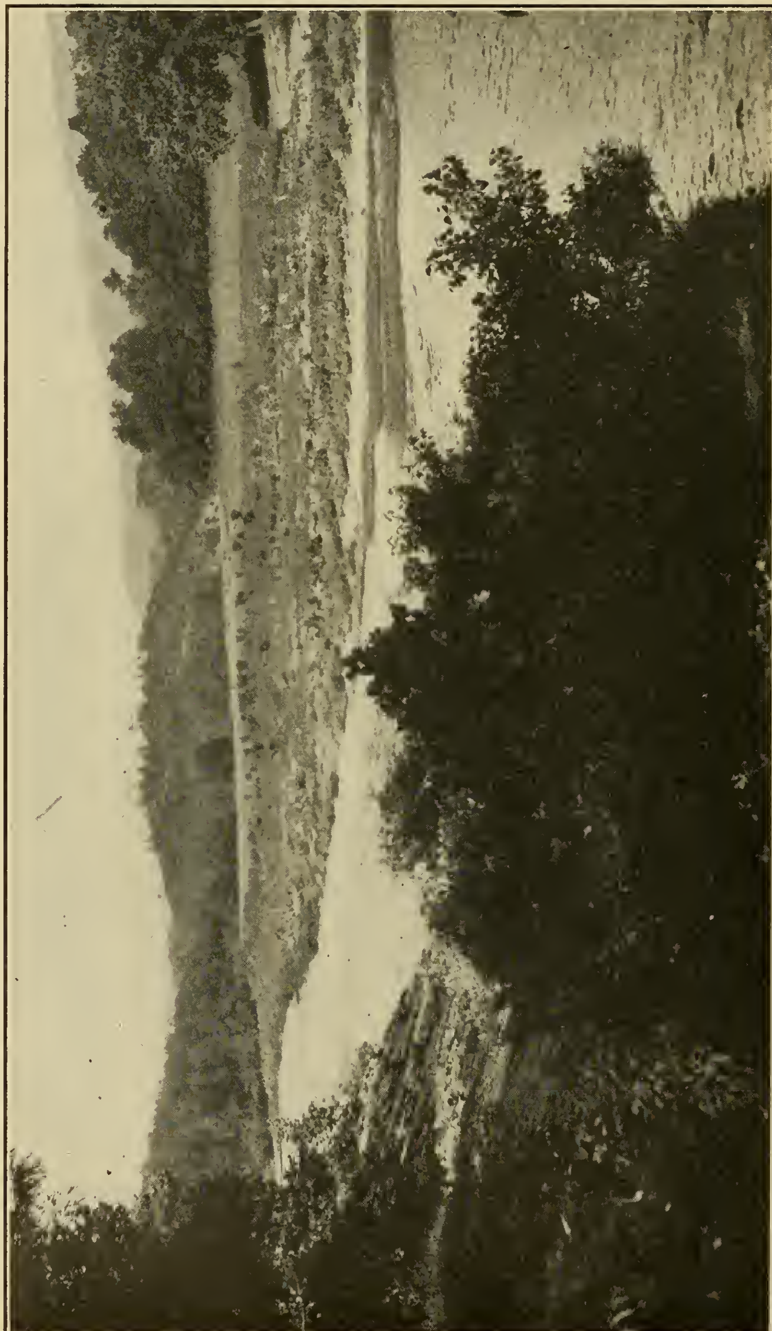

PLATE VII.—View northeast down the valley of South Branch of Potomac River ¾ mile east of Raven Rock. (See page 21 for description of plate).

of the stream. Beyond this to elevation 650 feet above sea-level, just above the Forks of Cacapon, the river drops 50 feet in 2.1 miles, or at the rate of 24 feet per mile. From this point to eight miles below the Forks of Cacapon, the combined waters of Cacapon and North Rivers fall but 50 feet in eight and three-fourths miles, below which there is a drop of 15 feet in 8.56 miles, averaging 1.8 feet per mile. From the county line to the mouth of the Cacapon, a distance of eighteen and three-fourths miles, following the larger bends, the fall is 150 feet, an average of 8 feet per mile. These facts will be cited again when the subject of water-power is under consideration, but just now what we want to note is that this powerful river still has places in the slope of its bed which it has not yet reduced—a characteristic of youth. The stream has a good current in all places and in some it is very rapid, with a slope that accommodates a quick run-off at high water.

DATA ON GRADIENTS.

Cacapon River, below the Forks of Cacapon.

Level of Potomac River at mouth of the Cacapon, 435 feet above sea-level.
Distance from mouth to county line at Largent, 18.75 miles.
Level of river at Largent, 585 feet.
Distance, 8.56 miles.
Contour at Bowers Run, 600 feet.
Distance, 8.75 miles.
Contour just above Forks of Cacapon, 650 feet.
Fall from Forks of Cacapon to county line at Largent, 65 feet; distance, 17.31 miles; average fall, 3.75 feet per mile.
Fall from Largent to mouth of Cacapon, 150 feet; distance, 18.75 miles; average fall, 8 feet per mile.

Cacapon River, above the Forks of Cacapon.

Contour just above Forks of Cacapon, 650 feet.
Distance, 2.1 miles.
Contour above Castle Rock, 700 feet.
Distance, 3.4 miles.
Contour near Darbys Nose, 750 feet.
Distance, 7.1 miles.
Contour near Capon Chapel, 800 feet.
Distance, 8.4 miles.
Contour near Loman Branch, 850 feet.
Distance 5.5 miles.
Contour near Hawk Run, 900 feet.
Distance, 2.25 miles.
Level of river at county line, 916 feet.
Fall from county line to Forks of Cacapon, 266 feet; distance, 28.75 miles; average fall, 9.25 feet per mile.

North River above the Forks of Cacapon.

Contour just above Forks of Cacapon, 650 feet.
Distance, 3.5 miles.
Contour southeast of Union Church, 700 feet.
Distance, 5.2 miles.
Contour at Raven Rocks, 750 feet.
Distance, 5.3 miles.
Contour ¾ mile south of North River Mills, 800 feet.
Distance, 5.1 miles.
Contour opposite Independence School, 850 feet.
Distance, 6.0 miles.
Contour ½ mile northeast of Sedan, 900 feet.
Distance, 4.1 miles.
Contour 0.7 mile south of Union Church, 950 feet.
Distance, 2.7 miles.
Contour ½ mile northeast of Deep Run School, 1000 feet.
Distance, 2.4 miles.
Contour 1¾ miles below Rio, 1050 feet.
Distance, 1.1 miles.
Contour ½ mile below Rio, 1100 feet.
Distance, 1.1 miles.
Level at county line near Rio, 1150 feet.
Distance, 3.5 miles.
Contour at Rock Oak, Hardy County, 1350 feet.
Fall from Rock Oak to Forks of Cacapon, 700 feet; distance, 40 miles; average fall, 17.50 feet per mile.

South Branch of Potomac River.

Level of Potomac River at mouth of South Branch, 535 feet above sea-level.
Distance, 1.60 miles.
Level of river south of South Branch Depot, 540 feet.
Distance, 7.75 miles.
Contour ¾ mile above Blue Ford, 550 feet.
Distance, 11.88 miles.
Contour 2 miles east of Grace, 600 feet.
Distance, 10.37 miles.
Contour at Romney, 650 feet.
Distance, 10.50 miles.
Contour 1 mile north of Sector, 700 feet.
Distance, 3.90 miles.
Level at Hampshire-Hardy County line, 723.1 feet.
Fall from county line to mouth of South Branch, 188.1 feet; distance, 46.0 miles; average fall, 4.09 feet per mile.

South Branch, a somewhat larger stream than Cacapon, falls 188.1 feet within the county, a distance of 46.0 miles with due allowance for the large bends but not for the small ones. This gives an average fall of 4.09 feet per mile for the entire distance to the Potomac. The last nine miles the fall is very slight. This large stream has just about established its grade, mostly on a bed of shale. Yet the profile reveals small irregularities which the stream has not yet removed. Furthermore all these streams flow in trenches that have narrow flood-plains cut steeply into a terrace of gravel. The main rivers, then, have not yet passed the stage of youth since an uplift, or the removal of an obstruction down the Potomac (or both combined), enabled the stream to renew its action and trench a former flood-plain, now a terrace along the river. This same terrace is traceable along the Potomac.

Little Cacapon River.

Contour near mouth of Little Cacapon (0.8 mile south of the mouth of the stream), 520 feet above sea-level.
Distance, 4.4 miles.
Contour 1.0 mile south of Chimney Hollow, 600 feet.
Distance, 3.1 miles.
Contour 0.5 mile northeast of Hopkins Lick School, 650 feet.
Distance, 2.3 miles.
Contour 0.5 mile northeast of Creekvale, 700 feet.
Distance, 2.6 miles.
Contour 0.3 mile northeast of Higginsville, 750 feet.
Distance, 2.7 miles.
Contour at mouth of Three Churches Run, 800 feet.
Distance, 2.1 miles.
Contour 0.5 mile north of Trinton Hollow, 850 feet .
Distance, 1.7 miles.
Contour 0.2 mile north of Barnes Mill, 900 feet.
Distance, 1.5 miles.
Contour 1.3 miles above Barnes Mill, 950 feet.
Distance, 1.4 miles.
Contour 0.2 mile northeast of Frenchburg, 1000 feet.
Total fall, 480 feet; total distance, 21.8 miles; average fall per mile, 22 feet.

Mill Creek.

Level of water at mouth of Mill Creek, 658 feet above sea-level.
Distance, 1.5 miles.
Contour near the center of Mill Creek Gap, 700 feet.
Distance, 2.1 miles.
Contour 1.75 miles east of Junction, 750 feet.
Distance, 3.5 miles.
Contour 0.65 mile below Sandy Hollow School, 800 feet.
Distance, 2.5 miles.
Contour 0.5 mile south of Rada, 850 feet.
Distance, 1.2 miles.
Contour 0.9 mile north of Purgitsville, 900 feet.
Distance, 1.1 miles.
Contour at Purgitsville, on Elmlick Run, 950 feet.
Distance, 0.85 mile.
Contour 1.0 mile above Purgitsville, on Elmlick Run, 1000 feet.
Distance, 0.7 mile.
Contour 1.7 miles above Purgitsville, on Elmlick Run, 1050 feet.
Distance, 0.5 mile.
Contour ¼ mile north of Hardy County line, on Elmlick Run, 1100 feet.
Distance, 0.25 mile.
Level at Hardy County line, 1138 feet.
Total fall, 480 feet; distance, 14.2 miles; average fall per mile, 34.3 feet.

Meanders.—Further, Cacapon and South Branch swing in great meanders trenched in this old flood-plain. Whether the streams meandered prior to the time when they flowed at the level of this terrace now so conspicuous will be considered later; but it is clear the streams were meandering when flowing at the level of this terrace because the streams have sunk their meanders into that flood-plain. This is a characteristic found not only in Hampshire County but also in all the region drained by the Potomac and its tributaries. The cause affected the whole region.

The two following tables have been prepared by Paul H. Price showing Stream Data—total length of streams, total fall in feet, rate of fall per mile, air-line distances, and ratio of total distance to air-line distance—and Area of Drainage Basins in square miles:

Table of Stream Data.

Streams	Total Distance Miles	Total Fall Feet	Rate of Fall per Mile Feet	Air-line Distance Miles	Ratio T. D. to A. L. D.
Potomac River.					
North Branch of Potomac (Source to Hampshire Line)	96.18	2655	27.60	56.23	1.71
Green Spring Creek	8.2	560	68.29	7.0	1.17
South Branch of the Potomac (Source to mouth)	131.15	3065	23.37	94.40	1.39
South Branch (Source to Hardy Line)	63.15	2710	42.91	49.60	1.27
South Branch Potomac River, (Hardy line to Hampshire-Hardy)	21.5	160	7.44	17.3	1.24
South Branch Potomac River, Hampshire-Hardy line to Mouth)	46.0	190	4.13	28.4	1.62
Stony Run	1.6	555	346.87	1.5	1.07
Johns Run	3.1	490	158.06	2.3	1.35
Broad Run	2.3	480	208.69	1.9	1.21
Fox Run	3.7	360	97.30	3.6	1.03
Long Run	2.55	555	217.64	2.0	1.27
Allen Run	2.2	580	263.64	1.8	1.22
Buffalo Creek	4.7	660	140.92	3.2	1.47
Big Run	3.9	595	152.56	3.4	1.15
Sulphur Spring Run	2.7	625	231.48	2.4	1.12
Wergman Run	1.7	320	188.23	1.6	1.06
Mill Creek	14.5	1040	71.72	12.7	1.14
Core Run	3.3	1135	343.93	3.2	1.03
Dumpling Run (Moorefield Dist.)	3.4	590	173.53	2.4	1.42

Table of Stream Data (Continued).

Streams	Total Distance Miles	Total Fall Feet	Rate of Fall per Mile Feet	Air-line Distance Miles	Ratio T. D. to A. L. D.
Mayhew Run	1.3	430	330.76	1.2	1.08
Long Meadow Run	1.5	385	256.66	1.4	1.07
Sugar Run	1.3	230	176.92	1.2	1.08
Titus Run	2.4	915	381.25	1.8	1.33
Horselick Run	1.5	85	56.66	1.4	1.07
Camp Run	4.2	530	126.19	3.4	1.23
Elmlick Run	5.3	985	185.85	4.6	1.15
Stump Run	1.5	295	196.66	1.4	1.07
McDowell Run	4.3	832	193.49	3.3	1.30
Dry Run	2.2	500	227.27	1.9	1.16
Mill Run	8.5	1600	188.23	6.8	1.25
Buffalo Run	3.9	760	194.87	3.4	1.15
Stony Run (Romney Dist.)	3.8	743	195.53	3.5	1.08
Sawmill Run	6.0	865	144.17	3.5	1.71
Devils Hole Run	4.0	1190	297.50	3.6	1.11
Brushy Run	1.4	295	210.71	1.3	1.08
Little Cacapon River, (Source to mouth)	33.1	1312	39.63	24.6	1.34
Lapley Hollow	1.6	570	356.25	1.3	1.23
Dug Hill Run	3.2	440	137.50	2.6	1.23
Hopkins Lick Run	4.0	500	125.00	3.1	1.29
Crooked Run	7.3	740	101.37	5.9	1.24
Three Churches Run	4.15	420	101.20	3.4	1.22
Shawan Run	4.7	470	100.00	4.1	1.15
South Fork Little Cacapon River	8.3	675	81.32	7.6	1.09
North Fork Little Cacapon River	8.9	765	85.95	7.7	1.15
Camp Run	3.2	380	118.75	3.1	1.03
Cacapon River, (Cacapon and Lost River, from source to mouth)	110.9	2025	18.26	66.7	1.66
Cacapon River, (Mouth to Hampshire Line)	20.0	135	6.75	11.7	1.71
Cacapon River (Mouth to mouth of North River)	36.8	215	5.84	16.8	2.19
Cacapon River (Mouth to Capon Bridge)	48.7	370	7.59	24.2	2.01
Cacapon River (Mouth to Hampshire-Hardy Line)	68.5	490	7.15	37.7	1.82
Cacapon River (Mouth to Wardensville)	74.5	570	7.65	42.0	1.77
Critton Run	5.6	725	129.46	4.2	1.33
Falling Spring Run	2.4	1685	702.08	2.0	1.20
Bowers Run	1.1	190	172.73	1.1	1.00
North River	48.5	1275	26.29	29.7	1.63
Castle Run	3.3	745	225.75	3.2	1.03
Maple Run	5.9	570	96.61	4.15	1.42
Hiett Run	5.7	520	91.23	1.9	3.00

Table of Stream Data.—(Continued)

Streams	Total Distance Miles	Total Fall Feet	Rate of Fall per Mile Feet	Air-line Distance Miles	Ratio T. D. to A. L. D.
Gibbons Run	5.2	550	105.76	3.5	1.48
Tearcoat Creek	16.2	775	47.84	11.6	1.39
Bearwallow Creek	4.3	525	122.09	3.25	1.32
Turkeyfoot Run	1.8	210	116.66	1.7	1.06
Pine Draft Run	4.7	505	106.31	4.1	1.15
Mick Run	1.65	375	227.27	1.5	1.10
Deep Run	1.9	380	200.00	1.6	1.19
Sperry Run	7.6	1145	150.65	5.8	1.31
Meadow Run	6.8	1165	171.32	6.7	1.01
Grassy Lick Run	7.1	405	57.04	5.85	1.21
Waterlick Run	4.3	530	123.25	3.9	1.10
Horn Camp Run	5.4	765	141.66	4.5	1.20
Skaggs Run	6.4	675	105.47	5.0	1.28
Bloomery Run	7.6	730	96.05	4.7	1.62
Cold Stream	3.2	645	201.56	2.8	1.14
Edwards Run	6.7	440	65.67	6.2	1.08
Dillons Run	11.7	630	53.84	10.0	1.17
Gunbarrel Hollow	7.0	815	116.42	6.3	1.11
Mill Branch	8.3	425	51.20	6.7	1.24
Kale Hollow	5.5	920	167.27	5.3	1.04
Oldman Run	3.5	475	135.71	3.1	1.13
Crooked Run	2.9	460	158.62	2.5	1.16
Loman Branch	8.7	1455	167.24	5.1	1.70
Capon Springs Run (mouth to Spring)	4.3	525	122.09	4.0	1.07
Dry Run	4.8	1210	252.08	4.2	1.14
Himmelwright Run	3.4	910	267.64	1.5	2.27
Hawk Run	4.7	1245	264.89	4.2	1.12
Hornets Hollow	3.9	420	107.69	2.9	1.34
Grenspring Creek	8.4	650	77.38	7.0	7.20

Area of Drainage Basins.

Streams	Sq. Mi.
South Branch Potomac River	1492.66
Stony Run	7.70
Johns Run	4.17
Broad Run	3.50
Fox Run	6.86
Long Run	1.42
Allen Run	1.09
Buffalo Creek	6.52
Big Run	5.14
Sulphur Spring Run	1.17
Wergman Run	1.08
Mill Creek	50.10
Core Run	1.86

Area of Drainage Basins.—(Continued)

Streams	Sq. Mi.
Dumpling Run (Moorefield Dist.)	4.83
Mayhew Run	0.51
Long Meadow Run	7.05
Sugar Run	7.00
Titus Run	1.30
Horselick Run	1.11
Camp Run	5.40
Elmlick Run	8.82
McDowell Run	3.62
Mill Run	9.00
Buffalo Run	5.70
Stony Run (Romney Dist.)	4.23
Sawmill Run	14.76
Devils Hole Run	4.89
Little Cacapon River	106.94
Hopkins Lick Run	4.08
Crooked Run	10.95
Three Churches Run	7.84
Trinton Hollow	4.64
Shawan Run	4.70
South Fork Little Cacapon River	13.10
North Fork Little Cacapon River	15.87
Camp Run	5.40
Cacapon and Lost River	692.28
Critton Run	8.41
Falling Spring Run	1.20
North River	210.55
Castle Run	2.14
Maple Run	7.42
Hiett Run	8.40
Gibbons Run	6.74
Tearcoat Creek	37.23
Bearwallow Creek	8.32
Turkeyfoot Run	0.90
Pine Draft Run	2.99
Mick Run	1.86
Deep Run	2.52
Sperry Run	15.54
Meadow Run	4.78
Grassy Lick Run	10.41
Water Lick Run	6.58
Horn Camp Run	11.44
Bloomery Run	14.45
Ivy Run	4.83
Cold Stream	3.56
Edwards Run	7.10
Dillons Run	20.22
Gunbarrel Hollow	6.31
Mill Branch	13.11
Kale Hollow	3.92
Oldman Run	4.96
Crooked Run	8.41
Loman Branch	11.69
Capon Springs Run	10.31
Himmelwright Run	2.78
Hawk Run	3.57
Hornets Hollow	3.32
Greenspring Creek	12.33

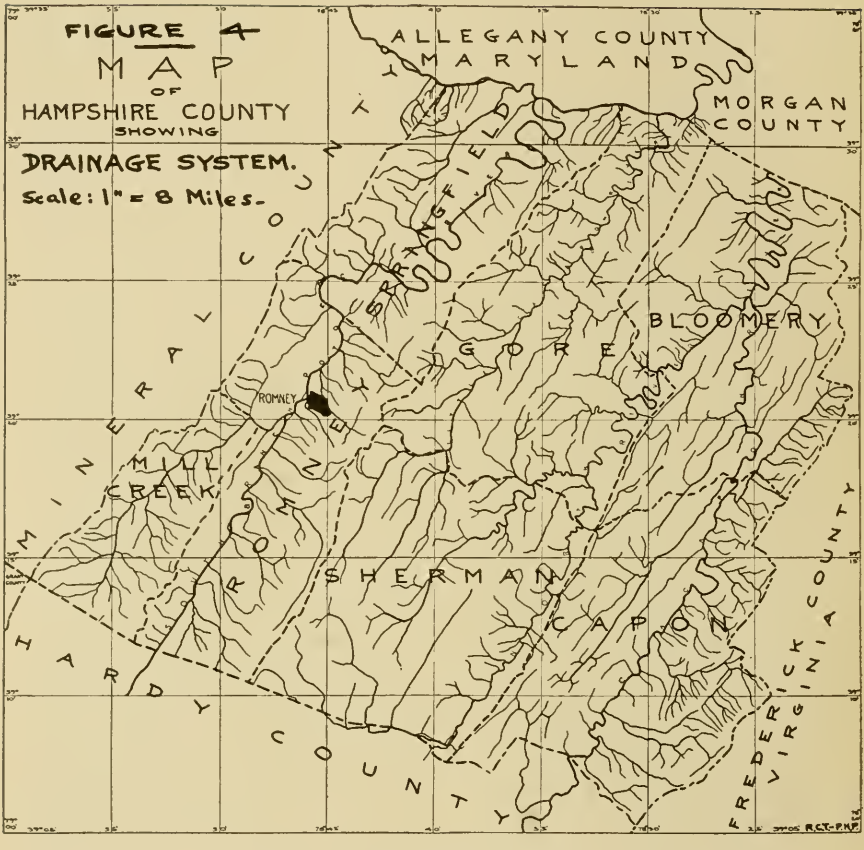

FIGURE 4.—Drainage System of Hampshire County, W. Va. (Paul H. Price, del.)

PLATE VIII.—Gravel in terrace in cut through north end of Valley Mountain, Baltimore and Ohio Railroad.

Terraces.—The gravel terrace just mentioned is a double terrace. The lowest rises about 15 feet above the river. Above this is a terrace rising 25 to 35 feet above the first, which latter is the terrace upon which Greenspring is located. Eighty feet above this there is some evidence of a higher terrace, and 40 feet still higher is the distinct terrace on the level on which Romney is located.

If the terraces elsewhere in the county are compared with these seen along South Branch a similar arrangement is noted. At Capon Bridge the town is on a terrace 35 feet above the river. West of Hanging Rock Gap the main level is 50 feet above the stream, thus corresponding to the level on which Greenspring and Capon Bridge are located. At Frenchburg this same level is noted. This last plain is not a gravel deposit along a stream, but a peneplain in accord with the terrace along the streams. The terraces and plains noted all rise higher above sea-level the greater the distance from the lower courses of the streams.

The Meanders are Entrenched.—We have noted that the Cacapon flows in large arcs of meanders below the Forks of Cacapon, have mentioned the meanders as entrenched in the gravels of the terraces that line its valley sides, and have noted that thus the river must have been meandering when flowing at the level of the river gravels in those terraces. The same is true with reference to the extensive flats at one point on which Romney is located about 180 feet above the river. The divides that reach out into the great meanders of the Cacapon consist of at least 200 feet of stratified rock dipping steeply, strata beveled, and in all but one of these bends reaching a height of 300 feet vertically of stratified rock. Even in the shales along South Branch the divides reaching out into the meanders rise at least 150 feet and in some cases as much as 200 feet above the river. Therefore these rivers were meandering when the level of the terrace at Romney and at Cold Spring School 180 feet above the present rivers was the level of the river drainage lines.

Gravels at High Levels.—As to the interpretation of high gravels, one must note that scattered gravels high above sea-level and at a distance from the principal streams do

DESCRIPTION OF PLATE IX.—Greenspring, as seen from the side of Valley Mountain on the east. In the center is the main line of the Baltimore and Ohio Railroad. On the right is the North Branch of Potomac River. Between river and railroad in the distant center is the creosoting plant with 2,000,000 railroad ties awaiting treatment. In the left center is the town of Greenspring. In the background on the right is Warrior Mountain in Maryland, and in the background on the left Patterson Creek Ridge in Mineral County, West Virginia.

PLATE IX.—View showing Greenspring from Valley Mountain on east. (See page 32 for description of plate).

not necessarily mean peneplains developed at that level. Southeast of Rio gravels were noted at 1230 feet above sea-level, but this is only 30 feet above present drainage lines in that region. At another point near Rio gravel was noted at an elevation of 1190 feet, but this was only 40 feet above the present drainage line in that region. Two miles southwest of Rada high gravels were noted along a road at 1450 feet above sea-level, which is there 600 feet above the main drainage east and located not far from Oriskany Sandstone. In several places residual material of resistant strata that unquestionably used to exist at those points above the present level of the topography was excluded as not of the character of river gravels.

The most important instance of high gravel noted is in the southwest corner of the county, 2.2 miles southwest of Purgitsville, where a deposit of chert pebbles and sand lay on a low divide of Marcellus Shale at an elevation of 1225 feet, 125 feet above the drainage line of that region.

With the exception of this last-named very significant deposit, it is evident that none of these observed instances of the presence of high gravel can be relied upon. Another instance that should not be overlooked is the presence of a bed of kaolin along the bottom of a valley below a mountain of Oriskany Sandstone one mile northwest of Cold Stream. Here at a level of perhaps 1550 feet above sea-level is a deposit of fine clay apparently from the decomposition of feldspathic material in Oriskany Sandstone, evidently a quiet-water deposit. An horizon of such fine sediment is certainly worthy of note as marking a level at which quiet deposition was once possible.

Cross-Sections.—Another line of evidence is open to consideration in the cross-sections that are presented in connection with this Report. The cross-section (A—A′) along the Potomac River shows the Marcellus Shale greatly crumpled and thrown into folds, but all the strata are eroded to a common plain 580 feet above sea-level, the plain of one of the terraces along the Potomac and the level on which the town of Greenspring is located. The same level appears farther east at the mouth of South Branch, and then along the lowland to a mile west of Okonoko. For a mile on both sides of Little Cacapon it is also evident. Whatever the strata that come to the surface they are reduced to a common level, the level of a river terrace covered with gravel found along the Potomac and found along the rivers that drain Hampshire County.

In the cross-section along the Morgan-Hampshire County line (B—B′), the surface of the shale along Cacapon River is found to mark the same level as at Greenspring. Above this level another is noticeable, being marked by the tops of the ridges. This level is 800 to 900 feet above sea-level immediately east of Greenspring near the main drainage line (South Branch), and 1000 feet in the high divide at Okonoko, between South Branch and Little Cacapon Rivers.

In the cross-section southeast through Springfield (D—D′), the same general relation is to be observed, excepting that the plains noted are a little higher. Across the valley along South Branch the level is 580 feet as at Greenspring not far away, but at North River it is about 750 feet, at Cacapon River 850, and east of Bear Garden Mountain 1000 feet, thus rising to the southeast. The higher ground shows a similar relationship: South Branch Mountain rises to 1500 feet. For eight miles to the east the high ground comes to within 250 feet of this high point. Across North River, Ice Mountain, Pine Mountain, and Bear Garden Mountain all rise to nearly this same level. The summits of Valley Mountain and River Mountain, which were not mentioned, have their heights determined by the presence of Oriskany Sandstone that holds up the anticlines; but not so in the other mountains, for in all other cases the strata are inclined and all folds alike are truncated to a common level.

In the cross-section along the Northwestern Turnpike (E—E′), the same is true. The valley floor of South Branch is at about 700 feet above sea-level, that of the South Fork of Little Cacapon River 1000 feet, of North River 900 feet, and of Cacapon River 850 feet. Mill Spring Mountain has maintained its height (1800 feet) better than the other mountains because of the presence of an arch of Oriskany Sandstone; but the other mountains show an elevation of approximately 1500 feet regardless of the folding of the strata. The strata are truncated whatever their dip, and the level of the valleys is approximately 1400 feet. Off to one side of the cross-section, mountains rise to 2050 feet above sea-level.

In the next cross-section (F—F′) through the point where the railroad between Winchester and Wardensville crosses the county line, the flat west of Mill Creek Mountain stands at 1000 feet. At South Branch the valley is at 700 feet, but a plain on both sides stands at 1000 feet. Between Piney Mountain and Short Mountain an inland plain stands at about 1700 feet. At North River and at Cacapon River the valley is again at 1000 feet. Along this line the mountains rise from 1500 feet at Mill Creek Mountain to 2500 feet at Piney Mountain and Short Mountain, 2000 feet at Baker Mountain, and 2870 feet at North Mountain.

In the cross-section (G—G') along the Hampshire-Hardy County line, the same relations exist. The valley west of Mill Creek Mountain is at 1100 feet, and the valley near Rio at the same level. The interior upland, as at Horn Camp, stands at 1500 feet, and the mountains rise to 2250 feet (Mineral-Hampshire line), 2150 feet at High Knob (Mill Creek Mountain), 2850 feet at South Branch Mountain, and 2150 feet at Flat Mountain, all regardless of the attitude of the strata.

Thus, in a direction at right angles to the strike, the summits of the mountains form somewhat of an arch, though when North Mountain and Cacapon Mountain are included there is a general rise to the southeast. Likewise the general level of the upland between the mountains forms an arch. The arch is dependent on the location of the strike of soft strata along which the large streams flow in valleys which have been deepened, and toward which the upland drainage is turned. This upland surface with its flat areas amid the mountains seem unmistakably to mark a peneplain.

From the preceding discussion it follows that the fine silt or clay and the distinct upland gravel correlate with the level of the dissected upland; and, since the divides between the large entrenched meanders of South Branch and Cacapon Rivers rise to approximately this upland level, the main streams were meandering on this level. (There is no evidence of meandering above this level). Above this level rose the hills and mountains of the time.

When the drainage line had been cut below the level of the dissected upland, it was then possible for the sink-holes and underground drainage so conspicuous in the region north of Capon Bridge to begin to form.

Correlation and Age of Peneplains.—Terraces and peneplains such as have been described are reported east, north, and west of Hampshire County. It is evidence that all are parts of a general whole. In tracing these topographic forms along the Potomac for the report on the Pawpaw-Hancock Folio and for correlation with areas farther north in Pennsylvania and New Jersey, several points were brought out that are of use in connection with similar features in Hampshire County. The flat top of Cacapon Mountain is in full accord as a part of the Schooley Peneplain developed in Jurassic-Comanchian time. Here also belong the flat portions that are left along the crest of Great North Mountain. The other mountains to the northwest have suffered a reduction below the level of the Schooley Peneplain, as revealed in the somewhat uneven heights and position in a broad arch

PLATE X.—View of Romney, W. Va., from the reservoir. (See page 38 for description of plate).

DESCRIPTION OF PLATE X.—View looking north over Romney from the reservoir. In the immediate background is Romney, with the court-house in the center. A block to the east (right) is the flat roof of the New Century Hotel on the Northwestern Pike. In the left center is the valley of the South Branch of Potomac River, which flows between Mill Creek Mountain in the extreme left and the divide that reaches out toward the left (west) just beyond Romney. This is a part of the terrace upon which Romney is located, here forming a broad area. In the back center of this area is a low cliff that marks the difference in elevation between this terrace and a lower terrace along the river. The flood-plain, below this low terrace, is not visible. In the right of the picture appears the long sloping ridge of South Branch Mountain.

between the main drainage lines. The highest points in these ridges are the remnants of resistant strata that have been cut down to their present level by erosion.

The intermontane region, or dissected upland, accords with the Harrisburg (Shenandoah) Peneplain in Cretaceous and early Tertiary time. To this level belong the high divides in the great meanders of Cacapon and South Branch Rivers, the entrenchment of which meanders began during the post-Harrisburg uplift and tilting that enabled the Potomac River to cut through Sideling Hill, thus enabling that river and its tributaries to entrench the meanders that had developed back of that obstruction, and to begin the development of a somewhat lower peneplain, the Somerville, in late Tertiary and early Pleistocene time. The position of the terrace at Romney and of other portions of the same terrace along South Branch is at too low a level for the Harrisburg Peneplain but accords well with the Somerville Peneplain, and refers the gravels encountered there to the Lafayette gravels. The flat east of Cold Stream School (950 feet above sea-level) is a remnant of this same terrace on Cacapon River.

The further uplift that followed the development of the Somerville Peneplain led to the development of the next peneplain, which is now a terrace about 60 feet above the present rivers. This is, then, the Columbia Terrace of early Pleistocene time, so well developed along the Potomac and elsewhere east along the coast. It is the terrace on which Greenspring and Capon Bridge are located. The next lower terrace, that between 12 and 15 feet above the present flood-plain, had its origin still later in the crustal movements in early post-Pleistocene time.

The Cretaceous and Tertiary peneplains can best be noted from high points that command a wide range of vision. The highest mountains rise to the level common to them. Below this level is the dissected level between the moun-

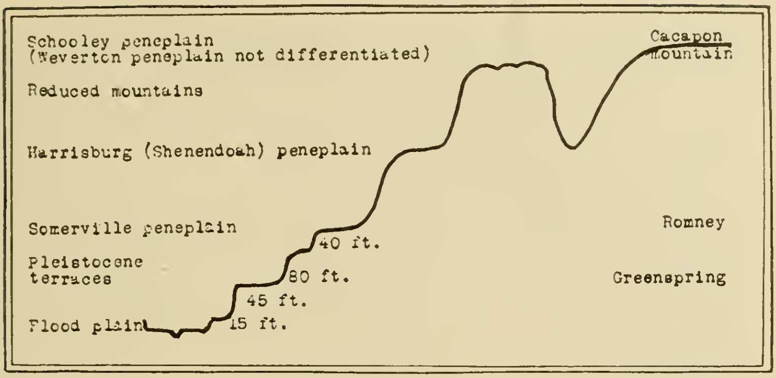

FIGURE 5.—The relation of the terraces and peneplains.

tains; while the lower Quaternary gravel terraces are features bordering the rivers.

To the west an inspection from the railroad from Cumberland to Morgantown and Kingwood Junction and thence to Morgantown gives a relation that is worth noting, though the judgment can not be considered final until the levels are carefully followed in the field. The mountains rising to a common plain mark a peneplain that may be called the Cretaceous peneplain and represent a modified Schooley Peneplain or Weverton Peneplain. This Cretaceous peneplain follows the tops of the highest ground over Briery Mountain near Terra Alta and then westward to the top of Chestnut Ridge (2200 feet above sea-level). Dorsey Knob and other high elevations near Morgantown are reduced remnants, continued westward by tops of the high hills that truncate the Nineveh Anticline. Below this highest peneplain is the dissected upland plain (early Tertiary, Harrisburg). To this are referred the high nose to the south of the track between Keyser and Piedmont, and the tops of the low knolls at Altamont. At Terra Alta these low knolls are continued, and between Kingwood and Cascade other knolls mark the general level on which Masontown is situated (1700 feet near Masontown). Farther west the level is that of low knolls. West from Hoard and west of Morgantown the level of this plain is 1100 feet.

Southwest from Cumberland the Quaternary gravel terrace is distinct, high above the flood-plain. Farther west, in the lower portions of Deckers Creek the Quaternary gravels appear. The Flats near Star City are at this level, and the business portion of Morgantown is built upon it.

PLATE XI.—View north from Bear Garden Mountain from a point one mile northeast of Capon Bridge. (See page 41 for description of plate).

DESCRIPTION OF PLATE XI.—View north from Bear Garden Mountain from a point one mile northeast of Capon Bridge. In the foreground is the low terrace just above the flood-plain along Cacapon River, back of which a higher terrace and peneplain at Cold Stream School is here unusually conspicuous. In the distance on the right Darbys Nose rises steeply from the river, and beyond Darbys Nose is the high ground of Pine Ridge. The highest ground marks the Schooley Peneplain.

There is a terrace of Quaternary gravels (Carmichael), into which the Monongahela River has trenched its meanders, so nicely shown in the geologic map of the Masontown-Uniontown Folio. A lower terrace lies about 15 feet above the river.

The terraces in Hampshire County and along the North Branch of the Potomac are of river gravel. The terraces along the Monongahela are of silts, sand, and gravel laid down during ponding caused by the Pleistocene ice blockade farther north. Both the river deposits east of the mountains (Hampshire County) and those west of the mountains (along the Monongahela) were affected by postglacial uplift.

CHAPTER III.

THE STRATA IN THE GEOLOGIC SECTION.

INTRODUCTION.

There are three general types of strata in the county: sandstone, shale, and limestone.

Sandstone.—Sandstone of the kinds here found consists of fine rounded pebbles of quartz, mixed with other darker fine material, and all cemented together by iron oxide and silica (quartz) deposited in between the round pebbles. In this general condition it represents an old deposit of sand which, when containing the remains of sea shells, was deposited along a seashore. Large pebbles one-fourth of an inch in diameter are pebbles coarse enough for the stone to be called conglomeratic, while pebbles half an inch or more in diameter form a definite conglomerate. If thoroughly cemented with quartz the stone is called a quartzite. If the cementing quartz is pure the quartzite is white. If the cementing material contains iron oxide the color is reddish. Where the pebbles are rounded it indicates that somewhere in their history they have been rolled over and over by stream action. If the pebbles are flattish with rounded edges it indicates a considerable rocking back and forth by wave action. Conglomerates thus indicate the presence of water in motion. Where the conglomerate can be traced distributed over wide areas it indicates wide shore conditions where wave action was considerable and shore currents removed the finer material and transported it to regions where a less vigorous current permitted deposition. Conglomerates thus grade into sandstone from the region of vigorous wave or stream action toward the region of quiet waters, and grade from a pure deposit of white quartz pebbles to a finer deposit with considerable darker material, sometimes with lime included so that the sandstone becomes calcareous.

Shale.—Shale is the name for a mud of former times. If it contains considerable light-colored clay the shale is light colored. If it contains considerable iron along with the clay, the shale may be red, green, or even black, depending on the condition of the iron compounds. A darker color may also be due to dark minerals whose minute fragments form a portion of the mud, or to carbon from former soil or swampy deposits. It may even contain lime and be recognized as a calcareous shale. Shale in its finest state is thus a deposit under quiet conditions. If laid down within the limit of wave vibrations the surface subject to such action becomes ripple-marked. If in a flat that is drained for a time by ebb of the tide, the portion uncovered becomes dried, mud-cracks are formed, and tracks of animals are preserved.

Limestone.—Where limestone is full of fragments of shells of animals, it formed where there was little sediment of other kinds. These fragments give a good idea of the life of the time that could live under the conditions. In some places there are shell banks, in other places coral reefs. Such deposits do not represent deep-sea conditions, but represent clear-water conditions where the sea is not very deep and food and oxygen are abundant in the water. Toward shallow bays the lime deposits grade into a calcareous shale, and in favorable places lime may even be deposited by evaporation.

Sources and Significance.—As the sands and muds deposited are derived from the decomposition of rocks of land areas, the distribution of the material gives evidence of the distribution of marine conditions, the gradation horizontally tells of changes toward or from shore, and the gradation vertically tells of changes chiefly in depth affecting conditions of deposition. In any given locality the different conglomerates give evidence of shore conditions or current action. The varying sandstones and shales give evidence of conditions out from the shore, and sometimes of delta deposits, while the limestone tells of open water off the coast. Deposits of sandstone and shale are thicker near shore and thinner out from the shore. The various fossils found in limestone, shale, and sandstone help in tracing the extent of deposits laid down when these various forms lived.

In a general way the deposits are thicker and coarser toward the southeast, and thinner, finer, and more calcareous toward the northwest. This indicates a land toward the southeast from which the sediments were derived, and an open sea toward the northwest. Indeed, the general outlines of troughs, and of broad seas where now it is land farther west, have been traced by the character of the sediment and of the remains of the life of the time.

Such sediment is laid down essentially horizontally. While it is now in folds in the area under consideration, it is in Hampshire County easy to determine the original position of the beds. Arranged in the order of their deposition, they give us a geologic section of rocks for the county, and tell us of the general conditions of deposition. In the following table the strata are represented in the order of their deposition, the latest at the top:

Table of Strata.

	Thickness. Feet.	Total. Feet.
Mississippian System:		
Hedges Shale	80	80
Purslane Sandstone and Conglomerate	220	300
Rockwell Shale and Sandstone	198	498
Devonian System:		
Upper Devonian:		
Catskill reddish shale and sandstone	1241	1739
Chemung gray sandstone and arenaceous shale	1214	2953
Portage, clayey, with thin layers of fine sandstone	1268	4221
Genesee, dark, clayey and calcareous shale	300	4521
Middle Devonian:		
Hamilton, shale, dark, fossiliferous	265	4786
Marcellus, dark, concretionary shale	520	5306
Lower Devonian:		
Oriskany Series:		
Ridgeley Sandstone	170	5476
Shriver Chert, dark	203	5679
Helderberg Series:		
New Scotland, white cherty limestone	23	5702
Coeymans Limestone	60	5762
Keyser Limestone	50	5812
Silurian System:		
Salina Series:		
Bossardville Limestone, alternating dark and light	91	5903
Rondout Waterlime, a calcareous shale	200	6103
Bloomsburg Shale and reddish sandstone	52	6155
Niagara Series	62	6217
Clinton Series	619	6836
White Medina Series (Tuscarora)	250	7086
Red Medina Series (Juniata)	200	7286
Gray Medina Series (Oswego)	100?	7386
Ordovician System:		
Maysville Series	?	....

General Outline of History of Deposition.—The general character of the deposits reveals the general changes in the condition of deposition. At the time of the deposition of the Maysville, Hampshire County and all of Virginia were beneath the waters of the Appalachian trough. The shore was to the east, somewhere near Washington Junction, beyond which eastward rose the heights of old Appalachia, the continent from which sediment was received until long after all of the strata now found in Hampshire County were laid down. The uplift that followed the deposition of the Maysville is thought to be marked by an unconformity the exact position of which is not fully agreed upon. Apparently it was a disconformity of short duration. The red of the Red Medina is due to the presence of oxidized material from near-by land. The White Medina with its conglomerate so spread north and south indicates the presence of a shore of a crystalline area not far away, and points to an uplift of Appalachia during which erosion that had previously cut through the shale and oxidized material cut deeply into granite and supplied the white quartz of the White Medina that was transported to the shore-line where wave action gave a noticeable flatness to the pebbles. This region evidently suffered somewhat of an uplift at the time of the Taconic revolution in eastern New York.

During Clinton time shore conditions prevailed in which large flats along the shore became centers of deposition of ferruginous material and of marine forms, the lime of whose shells was gradually displaced by iron oxide. Locally the deposition of shale continued without the deposition of iron-bearing sediment during the Niagara epoch while farther west limestone was laid down. Again shallow-water conditions prevailed as the Bloomsburg Red Sandstone and Shale were laid down, followed by increasingly more marine conditions in which at first calcareous shale was formed, and then an abundance of limestone with interbedded shale. All through the time of deposition of the Keyser, Coeymans, and New Scotland, open marine conditions prevailed with an abundant fauna of corals, Stromatoporas, and brachiopods. Following the time of deposition of the New Scotland, there was a short time when deposition ceased in this region, for no Becraft strata have been found, as in Pennsylvania and New Jersey. The disconformity is slight, followed again by deposition of siliceous limestone (Shriver Chert), then calcareous sandstone, and then of a great bed of resistant sandstone (Ridgeley) of a sandy shore. On depression of the area again first fine mud was deposited, then somewhat farther from the shore the calcareous muds of the Hamilton and Genesee. In the Portage and Chemung time there was a gradual change from the conditions in which mud was deposited to those in which sand was laid down along a coast in which ripple-marked strata were common—thirteen different beds were counted in a short distance. Occasional beds of conglomerate marked extreme shore conditions until there came a time when the continental phase of red shale and sandstone was deposited as a part of an extensive flat or delta

(Catskill). The next subsidence was only to the stage of deposition of sandstone and shale, after which the Purslane Conglomerate repeats the evidence of wave action along a shore to which crystalline pebbles are brought by the rivers and further worked over by the waves. In the final subsidence of which the strata of Hampshire County give evidence, the shore conditions were more swampy, as evinced by the black Hedges Shale. Undoubtedly there were other deposits laid down here as in other counties not far distant, but in the gradual crushing and uplift that culminated in Permian time the strata thus exposed were removed by erosion, and, in the time that followed through the Mesozoic and Cenozoic up to the present, all the overlying strata were removed down to the strata that remain, which in the eastern part of the county means all down into the Ordovician.

Briefly, and confining the outline to the evidence from strata still left in the county, the county has been an area of marine and delta deposition from near the close of the Ordovician until the Permian uplift, with the exception of two occasions of disconformity. The deposits in the main are near-shore deposits, the character of which is varied by local changes in level and by pronounced distant disturbances that affect the area.

THE ORDOVICIAN SYSTEM.

LOWER MAYSVILLE SERIES (MAP SYMBOL, Oms).

In Hampshire County the Ordovician System is represented by but one series, the Lower Maysville, in the upper portion of the Martinsburg Shale, and this is not well exposed in the county. Just west of Eagle Rock in the southeastern corner of the county, a valley cut along the axis of a small fold (anticline) in a large anticline reaches down through the shaly non-fossiliferous Gray Medina (Oswego) into the yellowish (weathered) clayey shale in which a few fragments of fossils were found too imperfect for exact identification. Some were crinoid stems and some were fragments of brachiopods that were thought to belong to the upper portion (Lower Maysville) of the Martinsburg Shale, so well exposed in the large valley to the east (in Virginia). It seems probable that these fossils mark the Lingula nicklesi zone, but distinct recognition of that zone seemed impossible.

The following figure prepared by Paul H. Price shows the outcropping rocks of the Martinsburg Series in the County, all occurring in the southeastern part of Capon District:

FIGURE 6.—Map of Hampshire County showing Martinsburg Series.

The fossils that are listed in the Maryland Report on the Cambrian and Ordovician (page 170) as found in the Lower Maysville are as follows:

Lower Maysville Fossils.

Lingula nicklesi Bassler.
Plectorthis plicatella Hall
Rafinesquina alternata Emmons
Rafinesquina squamula James
Orthorhynchula linneyi James
Zygospira modesta Hall
Zygospira erratica Hall
Ischyrodonta unionoides Meek
Pterinea (Caritodens) demissa Conrad
Byssonychia radiata Hall
Byssonychia praecursa Ulrich
Allonychia ovata Ulrich
Modiolopsis modiolaris Conrad
Modiolodon truncatus Hall
Orthodesma nasutum Conrad
Liospira micula Hall
Orthoceras lamellosum Hall
Isotelus megistos Locke.

THE SILURIAN SYSTEM.

The members of the Silurian System are as follows, oldest at the bottom:

Silurian System:
Salina Series:
Bossardville Limestone } (Tonoloway)
Rondout Waterlime }
Bloomsburg Shale and Sandstone
Niagara Series..............................(Rochester)
Clinton Series .... { (Keefer) (Rose Hill)

White Medina Series (Tuscarora)
Red Medina Series (Juniata)
Gray Medina Series (Oswego).

There is not yet unanimity as to what forms the base of the Silurian. In New York, the Survey places the base at the bottom of the Richmond, which has been found to be the equivalent of the Red Medina (Juniata). The Maryland Survey had considered the base of the Silurian as at the bottom of the White Medina (Tuscarora) above the Red Medina prior to the time when R. S. Bassler wrote the Report on the Cambrian and Ordovician of that State, in which Report Bassler expresses his judgment that the base of the Silurian is at the base of the Red Medina rather than above it, and presents a good argument that the Gray Medina (Oswego) is the Upper Maysville (McMillan, fossiliferous in the Ohio Valley), and that the **Orthorhynchula** zone is the Lower Maysville, both thus in the upper part of the Ordovician [1]

[1] R. S. Bassler, Maryland Geological Survey, Ordovician and Cambrian, pp. 171-2; 1919.

The following figure prepared by Paul H. Price shows the outcropping rocks of the Silurian Period in Hampshire County:

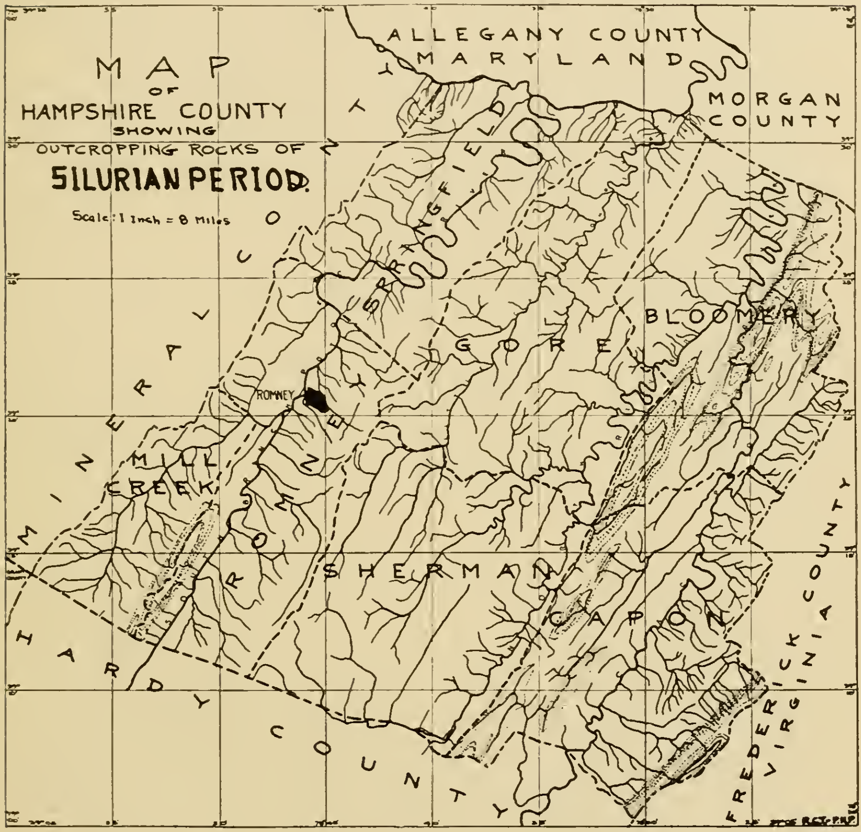

FIGURE 7.—Map of Hampshire County showing Outcropping Rocks of Silurian Period.

The West Virginia Survey has considered the base of the Silurian as at the base of the Gray Medina[2] (Oswego). This, for the Red Medina, has been sustained by the presence of what is probably **Arthrophycus** in the Red Medina as well as in the White Medina, as reported by D. B. Reger[3] and W. F. Prouty, and by the presence of a conglomerate at the base of the Gray Medina not far away.[4] On the other hand they report a form somewhat like **Lingula nicklesi** up in the Red Medina. The underlying non-fossiliferous Gray Medina (Oswego) it is thought better to continue to include with the Silurian rather than transfer it to the Ordovician (Upper Maysville) until there is definite proof from the Gray Medina itself that it is really the Upper Maysville.

GRAY MEDINA SERIES (MAP SYMBOL, Sgm).

The Gray Medina is not well exposed in the county, there being but one locality where it is found. That is the valley mentioned just west of Eagle Rock where erosion has exposed the top of the underlying Lower Maysville. The shale between that horizon and the base of the Red Medina is unfossiliferous (Oswego).

RED MEDINA SERIES (MAP SYMBOL, Srm).

The Red Medina is a fine-grained, thin-bedded, quartzitic sandstone, reddish in color, iron oxide forming a part of the cement between the small pebbles of quartz. There is no opportunity in the county to determine the full thickness of the Red Medina, since the base of it is not visible. Along Falling Spring Run, which is situated north of Bloomery Gap and in the west flank of Cacapon Mountain, about 15 feet of Red Medina may be seen in place in the side of the run. On the road through the Shenandoah National Forest southeast of Capon Springs, the Red Medina appears, but is largely concealed. In North Mountain near the Potomac, Stose

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[2]See D. B. Reger, Geology of Mineral and Grant Counties, W. Va. Geological Survey, p. 424; 1924

[3]Geology of Mineral and Grant Counties, W. Va. Geological Survey, p. 421; 1924.

[4]See also the recognition of unconformity between the Marcellus Shale and the Gray Medina (Oswego). Charles Schuchert (quoting George H. Ashley): Significance of the Taconic Orogeny. Bull. Geol. Soc. Am., Vol. 36, p. 344; 1925.

reports the thickness to be about 200 feet; which appears to be about the thickness in Hampshire County, for west of Eagle Rock 500 feet includes the combined thickness of the Red and Gray Medinas. In Mineral and Grant Counties, it is reported to be from 700 to 1100 feet thick. It is non-fossiliferous.

WHITE MEDINA SERIES (MAP SYMBOL, Swm).

The White Medina is a dense, white, coarse sandstone cemented with quartz, thus, where well cemented, constituting a quartzite. It is very resistant to weathering and forms the crest of Cacapon Mountain north of Bloomery Gap, and the crest of North Mountain east of Capon Springs. In these two mountains the White Medina forms the crests of two huge anticlines, the western limbs of which are vertical and the eastern limbs with less-marked dip. Along the crests of these mountains lies the boundary between Virginia and West Virginia.

A good place in which to measure the thickness of the White Medina is at the "Bear's Den" on Falling Spring Run, western part of Cacapon Mountain north of Bloomery Gap, where the White Medina stands in a nearly vertical position. Its thickness at this point is 250 feet.

Where seen the formation is non-fossiliferous. The only fossils reported are Arthrophycus harlani, Arthrophycus alleghaniensis, and Scolithus verticalis.

CLINTON SERIES (MAP SYMBOL, Scl).

In Hampshire County the Clinton Series consists of red shale with beds of iron ore near its base and a white sandstone (Keefer) at the top. At Bloomery Gap the top of the shale may be seen compressed into an anticline, but no satisfactory opportunity was noted to get its thickness. In the western part of Cacapon Mountain the Clinton Shale and reddish sandstone are vertical and about 520 feet thick and the Keefer Sandstone about 89 feet thick. The Clinton Shale and reddish sandstone outcrop around Cacapon Mountain and through Bloomery Gap southwest to east of Hanging Rock Gap. In the west flank of North Mountain it is largely concealed, but there are numerous fragments of the ore scattered along the road through the Shenandoah National Forest. The Keefer Sandstone member of the Clinton is especially noticeable along the road through Bloomery Gap, where in the plunging of the strata southwest from Cacapon Mountain the minor folds bring the Keefer Sandstone to the level of the road repeatedly. For three miles southwest this sandstone supplies much of the sand in Sandy Ridge. On the Northwestern Turnpike at a point two miles northeast of Hanging Rock Gap, the road crosses two limbs of a fold of Keefer Sandstone, the western of which has a dip of 63° northwest and is 89 feet thick.

The shales as a whole, and the ore especially, are fossiliferous. Stropheodonta corrugata Conrad and Bollia lata Vanuxem are guide fossils.

LIST OF FOSSILS.

It seems advisable to insert at the end of the description of each system a list of such fossils as have been identified in the neighboring regions. The names of forms that have been identified by the writer, either from Hampshire County or from Mineral and Grant Counties, are checked with the figure 1. The names of forms that have been identified by W. F. Prouty are checked with a figure 2. The names of those recorded in the report on the geology of Morgan County or in the Pawpaw-Hancock Folio of the United States Geological Survey, which two lists are essentially alike, are checked with a figure 3. Those recorded in the reports on the geology of Maryland are checked with a figure 4. The Maryland reports are very complete and are standards of reference on both range and distribution. Forms that are especially characteristic are marked with an asterisk (*).

Fossils of the Clinton Series.

Plantae
- Buthotrephis gracilis 2, 4
- Buthotrephis gracilis var. intermedia 2

Vermes
- Cornulites cingulatus Hall 4
- Cornulites rosehillensis Prouty 4
- Cornulites cancellatus Prouty 4
- Scolithus keeferi Prouty 4

Brachiopoda
- Orbiculoidea clarki Prouty 4
- Pholidops squamiformis Hall 4
- *Dalmanella elegantula Dalman 1, 3, 4
- Rhipidomella hybrida Sowerby 4
- *Leptaena rhomboidalis Wilckens 1, 2, 4
- *Stropheodonta corrugata Conrad 4
- Stropheodonta corrugata var. pleuristriata Foerste 4
- Stropheodonta convexa Prouty 2, 4
- Stropheodonta deflecta Prouty 4
- Stropheodonta acuminata Prouty 4
- Stropheodonta prisca 3
- Schuchertella subplana Conrad 2, 4

Schuchertella tenuis Hall 4
Schuchertella rugosa Swartz 4
Schuchertella elegans Prouty 4
Chonetes novascoticus Hall 4
Conchidium cumberlandicum Prouty 4
*Camarotoechia (?) neglecta Hall 1, 2, 3, 4
Camarotoechia litchfieldensis Schuchert 4
Camarotoechia litchfieldensis var. marylandica Swartz 4
Camarotoechia tonolowayensis Swartz 4
Uncinulus stricklandi Sowerby 4
Atrypa reticularis Linnaeus 2, 4
Atrypa ? gibbosa 3
Spirifer (Delthyris) crispus Hisinger 2, 4
Spirifer (Eospirifer) radiatus Sowerby 4
Spirifer (Eospirifer) eudora Hall 4
Spirifer (Eospirifer) niagarensis Conrad 4
Reticularia bicostata Vanuxem 4
Reticularia bicostata var. marylandica Prouty 4
Trematospira camura Hall 4
Anoplotheca camilla Hall 3
Whitfieldella marylandica Prouty 4
*Whitfieldella intermedia Hall 1, 3
Whitfieldella subovata Prouty 4
Meristina maria Hall 2, 4
Meristina globosa Prouty 4
Coelospira (Anoplotheca) hemispherica Sowerby 3, 4
Coelospira sulcata Prouty 4

Pelecypoda

Grammysia kirklandi Prouty 4
Ctenodonta subcircularis Prouty 4
Ctenodonta ovata Prouty 4
Ctenodonta willsi Prouty 4
Clidophorus nitidus Prouty 4
Clidophorus suboblongatus Prouty 4
Pterinea emacerata Conrad 4
Pterinea elongata Prouty 4
Pterinea cancellata Prouty 4
Liopteria subplana Hall 4
Modiolopsis cumberlandicus Prouty 4
Modiolopsis subcarinatus Hall 4

Gastropoda

Buchanella trilobata Conrad 4
Oxydiscus compressus Prouty 4
Bellerophon marylandicum Prouty 4
Poleumita transversa Prouty 4
Orthonychia clarki Prouty 4
Platyceras paucispirale Prouty 4
Platyceras niagarense Hall 4
Diaphorostoma niagarense Hall 2, 4
Coleolus interstriatus Prouty 4
Tentaculites minutus Hall 4
Tentaculites niagarensis Hall 2, 4
Tentaculites niagarensis var. cumberlandiae Hall 4
Conularia niagarensis Hall 3, 4

Cephalopoda

Orthoceras bassleri Prouty 2, 4
Orthoceras impressum 2
Cycloceras clintoni Prouty 4
Sphyradoceras cf. desplainense McChesney 4

Trilobita
- Encrinurus ornatus Hall and Whitfield 4
- *Liocalymene clintoni Vanuxem 2
- Calymene niagarensis Hall 4
- Calymene macrocephala Prouty 4
- *Calymene cresapensis Prouty 2, 4
- Calymene clintoni Vanuxem 3
- Homalonotus delphinocephalus Green 4
- Homalonotus lobatus Prouty 4
- *Dalmanites limulurus Green 4

Ostracoda
- Leperditia alta cacaponensis Ulrich and Bassler 4
- Aparchites (?) variolatus Ulrich and Bassler 4
- Eridoconcha rotunda Ulrich and Bassler 4
- Primitiella equilateralis U. and B. 4
- Euprimitia buttsi U and B. 4
- Laccoprimitia resseri U. and B. 4
- Chilobolbina, several species, 4
- Paraechmina, several species, 4
- Zygobolba, several species, 4
- Mastigobolbina, several species, 4
- Bonnemaia, several species, 4
- Zygobolbina, several species, 4
- Zygosella, several species, 4.

NIAGARA SERIES (MAP SYMBOL, Sna).

In this area the Niagara Series consists of a shale, buff in color, that lies above the white Keefer Sandstone of the Clinton and below the reddish Bloomsburg Shale and Sandstone. On the Northwestern Turnpike at a point two miles northeast of Hanging Rock Gap, the Niagara Shale is 62 feet thick. In Bloomery Gap it has about the same thickness. It outcrops around Cacapon Mountain, thence through Bloomery Gap southwest through the folds east of Hanging Rock Gap to Dutch Hollow east of Staacks Gap. West of North Mountain it is concealed along the flank of the mountain. In Mill Creek Mountain it lies along the crest of the mountain west of Sector, and is exposed along the road west from that place, but without opportunity for measurement.

Among fossils, Ostracods are abundant, Dalmanites and Tentaculites are common, and Lingula occasional. Whitfieldella cylindrica is especially characteristic, though it is also found in the Clinton Series.

Fossils of the Niagara Series.

(See statement preceding the List of Fossils of the Clinton Series).

Plantae
- Buthotrephis gracilis 3

Coelenterata
- Favosites niagarensis Hall 3, 4
- Favosites marylandicus Prouty 4
- Aulopora tonolowayensis Swartz 3, 4
- Stromatopora constellata Hall 3, 4

PLATE XII.—Mouth of old diggings for Clinton Iron Ore, Bloomery Gap, Hampshire County, W. Va.

Brachiopoda
- Lingula clarki Prosser 4
- Lingula subtruncata Prouty 4
- Orbiculoidea clarki Prouty 4
- Dalmanella elegantula Dalman 2, 4
- Dalmanella postelegantula Weller 3
- Rhipidomella hybrida Sowerby 2
- Leptaena rhomboidalis Wilckens 2, 4
- Stropheodonta corrugata Conrad 2, 4
- Stropheodonta corrugata var. pleuristriata Foerste 2, 4
- Stropheodonta varistriata Conrad 4
- Stropheodonta bipartita var. nearpassi Barrett 4
- Schuchertella interstriata Hall 4
- Schuchertella rugosa Swartz 4
- Stenochisma lamellata Hall 4
- Camarotoechia andrewsi Prouty 4
- Camarotoechia litchfieldensis Schuchert 4
- Camarotoechia litchfieldensis var. marylandica Swartz 4
- Uncinulus tonolowayensis Swartz 4
- Uncinulus marylandicus Swartz 4
- Uncinulus obsolescens Swartz 4
- Uncinulus pyramidatus 3
- Uncinulus obtusiplicatus Hall 4
- Rensselaeria subglobosa Weller 4
- Spirifer mckenzicus Prouty 4
- Spirifer (Delthyris) vanuxemi Hall 4
- Spirifer (Delthyris) vanuxemi var. tonolowayensis Swartz 4
- Spirifer (Delthyris) keyserensis Swartz 4
- Spirifer (Delthyris) corallinensis Grabau 4
- Spirifer eriensis Grabau 3
- Reticularia bicostata Vanuxem 4
- Reticularia bicostata var. marylandica Prouty 2
- Rhynchospira globosa Hall 4
- Homeospira evax var. marylandica Prouty 2, 4
- Trematospira camura Hall 4
- Hindella (?) (Greenfieldia) congregata Swartz 4
- Hindella (?) (Greenfieldia) congregata var. intermedia Swartz 4
- Hindella (?) (Greenfieldia) congregata var. pusilla Swartz 4
- Hindella (?) (Greenfieldia) rotundata Whitfield 4
- Whitfieldella marylandica Prouty 2, 4
- *Whitfieldella cylindrica Hall 1

Pelecypoda
- Cuneamya ulrichi Prouty 4
- Ctenodonta subreniformis Prouty 4
- Clidophorus nitidus Prouty 4
- Pterinea flintstonensis Prouty 4
- Liopteria pennsylvanica Swartz 4
- Modiolopsis gregarius Swartz 4
- Modiolopsis leightoni Williams 4
- Orthonota (?) marylandica Swartz 4

Gastropoda
- Hormatoma rowei Swartz 4
- Hormatoma rowei var. nana Swartz 4
- Hormatoma marylandica Prouty 4
- Hormatoma hopkinsi Prouty 4
- Solenospira minuta Hall 4
- Holopea (?) flintstonensis Prouty 4
- Poleumita mckenzica Prouty 4
- Diaphorostoma niagarense Hall 4

Tentaculites niagarensis Hall 4
Tentaculites niagarensis var. cumberlandiae Hall 4
Tentaculites gyracanthus Eaton 4
Tentaculites gyracanthus var. marylandicus Swartz 4

Cephalopoda
Orthoceras mckenzicum Prouty 4
Trochoceras (?) marylandicum Swartz 4
Oncoceras mckenzicum Prouty 4
Tetrameroceras cumberlandicum Swartz 4
Tetrameroceras cumberlandicum var. magnacameratum Swartz 4

Trilobita
Corydocephalus ptyonurus Hall 4
Encrinurus ornatus Hall and Whitfield 4
Liocalymene clintoni Vanuxem 4
Calymene niagarensis var. restricta Prouty 4
Calymene macrocephala Prouty 4
Calymene camerata Conrad 4
Dalmanites limulurus Green 2

Eurypterida
Eurypterus flintstonensis Swartz 4
Hughmilleria shawangunk Clarke and Ruedemann 4
Dolichopterus cumberlandicus Swartz 4

Ostracoda
Leperditia alta Jones 1, 3, 4
Leperditia faba Hall 1
Paraechmina altimuralis Ulrich and Bassler 4
Paraechmina bimuralis Ulrich and Bassler 4
Paraechmina postmuralis U. and B. 4
Zygobeyrichia incipiens U. and B. 4
Kyammodes swartzi U. and B. 4
Drepanellina claypolei U. and B. 4
Eukloedenella, many species, 4
Kloedenella, many species, 4
Dizygopleura, many species, 4
Bythocypris phillipsiana Jones and Hall 4
Bythocypris pergracilis U. and B. 4
Beyrichia mesleri U. and B. 4
Beyrichia moodeyi U. and B. 4

Pisces
Palaeaspis americana Claypole 4

SALINA SERIES.

The Salina Series includes three members:
Bossardville Limestone,
Rondout Shale and Limestone,
Bloomsburg Sandstone and Shale (at the base).

BLOOMSBURG SANDSTONE AND SHALE (MAP SYMBOL, Sbb).

In Maryland this basal sandstone and shale of the Salina Series is considered a part of the Wills Creek of that State. In Bloomery Gap the formation is a dark reddish sandstone fifty-two feet thick. In the anticline two miles east of Hang-

PLATE XIII.—A thirty-foot ledge of Keefer Sandstone dipping 53° 30′ southeast, close to old diggings for iron, Bloomery Gap, Hampshire County, W. Va.

ing Rock Gap the Bloomsburg is forty-five feet thick. West of Sector it is only thirty-one feet thick, above which there is a greenish shale.

The Bloomsburg Sandstone forms conspicuous ridges from Bloomery Gap southwest through the folds east of Hanging Rock Gap to Dutch Hollow east of Staacks Gap. West of North Mountain it appears along the National road up the west side of that mountain. It also appears along Mill Creek Mountain west of Sector.

The sandstone is not generally fossiliferous. In places Leperditia alta is abundant, this and Homeospira evax var. marylandica Prouty being the most characteristic fossils.

Fossils of the Bloomsburg Sandstone.

Lingula
*Homeospira evax var. marylandica Prouty
Tetrameroceras cumberlandicum Swartz
*Leperditia alta Jones
Leperditia alta var. brevicula Ulrich and Bassler
Leperditia elongata Weller
Leperditia altoides var. marylandica
Ctenobolbina (?) dubia Ulrich and Bassler
Bollia pulchella U. and B.
Bollia immersa U. and B.
Bollia nitida U. and B.
Halliella subequata U. and B.
Zygobeyrichia incipiens U. and B.
Zygobeyrichia ventricornis U. and B.
Eukloedenella umbilicata curta U. and B.
Dizygopleura unipunctata U. and B.
Kloedenia normalis U. and B.
Kloedenia kenziensis U. and B.
Kloedenia obscura U. and B.
Bythocypris pergracilis U. and B.

RONDOUT SHALE AND LIMESTONE (MAP SYMBOL, Srd).

This group consisting of shale and limestone lies above the distinct Bloomsburg Sandstone and below the Bossardville Limestone. In Maryland it is considered a part of the Wills Creek of that State. The shale is somewhat calcareous and includes dense dark-blue, somewhat banded limestone. Along the road west from Sector it is about 200 feet thick.

The Rondout Shale and Limestone is not a conspicuous member of the Salina Series, lying along the flank of the Bloomsburg Sandstone and along the areas of Bossardville Limestone.

The fossils are few in number, as given in the following list:

Fossils of the Rondout Shale.

*Schuchertella interstriata Hall
Uncinulus marylandicus Swartz
Uncinulus obsolescens Swartz
*Camarotoechia litchfieldensis Schuchert
Camarotoechia tonolowayensis Swartz
*Spirifer vanuxemi Hall
Hormatoma rowei Swartz
Calymene camerata Conrad
Hughmilleria cf. shawangunk Clarke and Ruedemann
Dolichopterus cumberlandicus Swartz
Leperditia elongata Weller
Leperditia altoides var. marylandica Weller
Leperditia alta Jones
Dizygopleura affinis Ulrich and Bassler
Kloedenia normalis U. and B.
Kloedenia normalis var. appressa U. and B.
Kloedenia obscura U. and B.

BOSSARDVILLE LIMESTONE (MAP SYMBOL, Sbo).

Other terms essentially synonomous are Tentaculite, Manlius, Tonoloway, Decker Ferry. The Bossardville Limestone is the uppermost member of the Salina Series. It is a dark grayish-striped limestone in which an alternation of thin layers of dark and light limestone is very evident. As seen west of Sector a thickness of as much as 91 feet is certain, but at this place it is difficult to determine upon the location of the Bossardville-Rondout contact. Here it outcrops through a considerable area. This formation is conspicuous in the limestone sink area three to six miles north of Capon Bridge, where it is the Bossardville Limestone that affords the underground drainage lines. At the east end of Bloomery Gap it outcrops along the hillsides.

The chief fossils are Ostracods, especially **Leperditia alta, Leperditia mathewsi, Welleria obliqua, and Dizygopleura concentrica.**

Fossils of the Bossardville Limestone.

(See statement preceding the List of Fossils of the Clinton Series).

Coelenterata
  Favosites globuliformis 3
  Favosites niagarensis Hall 4
  Aulopora tonolowayensis Swartz 4
  Stromatopora constellata Hall 4
Brachiopoda
  Leptaena rhomboidalis Wilckens 3
  Douvillina cayuta Hall 3
  Stropheodonta varistriata Conrad 4
  Stropheodonta bipartita Hall 3
  Stropheodonta bipartita var. nearpassi Barrett 4

Stropheodonta arctimuscula Schuchert 4
Schuchertella subplana Conrad 3
Schuchertella woolworthana Hall 3
Schuchertella interstriata Hall 4
Schuchertella rugosa Swartz 4
Schuchertella elegans Prouty 2
*Stenochisma (?) lamellata Hall 4
Camarotoechia tonolowayensis Swartz 2, 4
Camarotoechia litchfieldensis Schuchert 4
Camarotoechia litchfieldensis var. marylandica Swartz 4
Uncinulus marylandicus Swartz 4
Uncinulus obsolescens Swartz 4
*Spirifer (Delthyris) vanuxemi Hall 2
Spirifer (Delthyris) vanuxemi var. tonolowayensis Swartz 4
Spirifer (Delthyris) corallinensis Grabau 2, 3
Spirifer keyserensis Swartz 4
Spirifer eriensis Grabau 3, 4
*Rhynchospira globosa Hall 3, 4
Hindella (?) (Greenfieldia) congregata Swartz 2
Hindella (?) (Greenfieldia) congregata var. intermedia Swartz 4
Hindella (?) (Greenfieldia) congregata var. pusilla Swartz 4
Hindella (?) (Greenfieldia) rotundata Whitfield 4
Whitfieldella nucleolata Hall 3
Meristella bella Hall 3

Pelecypoda
Liopteria pennsylvanica Swartz 4
Modiolopsis gregarius Swartz 4
Modiolopsis leightoni Williams 2
Orthonota marylandica Swartz 4

Gastropoda
Hormatoma rowei Swartz 4
Hormatoma rowei var. nana Swartz 4
Solenospira minuta Hall 4
Holopea (?) flintstonensis Prouty 4
*Tentaculites gyracanthus var. marylandicus Swartz 3, 4

Cephalopoda
Trochoceras (?) marylandicum Swartz 4
Tetrameroceras cumberlandicum Swartz 4
Tetrameroceras cumberlandicum var. magnacameratum Swartz 4

Trilobita
Calymene camerata Conrad 3, 4

Eurypterida
Eurypteris flintstonensis Swartz 4

Octracoda
Leperditia elongata Weller 2
*Leperdita mathewsi Ulrich and Bassler 2, 4
Leperditia altoides Weller 3, 4
Leperditia scalaris praecedens U. and B. 4
*Leperditia alta Jones 2, 3, 4
Aparchites (?) punctillosa U. and B. 4
Halliella (?) triplicata U. and B. 4
Welleria, several species, 4
Kyammodes swartzi U. and B. 4
Kloedenella obliqua U. and B. 4
Dizygopleura, several species, 4
Octonaria muricata U. and B. 4
Bythocypris pergracilis U. and B. 4
Bythocypris phaseolus Jones 4

Beyrichia tonolowayensis U. and B. 4
Dibolbina cristata U. and B. 4
Dibolbina producta U. and B. 4
Pisces
Palaeaspis americana Claypole 4

THE DEVONIAN SYSTEM.

All the members of the Devonian System are represented within the county except the Becraft, which has not been recognized. They are related as follows, named in stratigraphic order, oldest at the bottom:

- Devonian System
  - Upper Devonian
    - Catskill Series
    - Chemung Series
    - Portage Series
    - Genesee Series
  - *Middle Devonian
    - Hamilton Series
    - Marcellus Series
      - Selinsgrove Limestone
      - Selinsgrove Shale
  - Lower Devonian
    - Oriskany Series
      - Ridgeley Sandstone
      - Shriver Chert
    - Helderberg Series
      - (Becraft Limestone absent)
      - New Scotland Cherty Limestone
      - Coeymans Limestone
      - Keyser Limestone.

LOWER DEVONIAN.

The Lower Devonian strata include the Helderberg Series below and the Oriskany Series above. Together they form a very resistant body of chert, sandstone, and limestone, standing out in massive form wherever in the folding of the strata they have been brought upward where erosion can take effect. Their resistance is such, both to compression and erosion, that they stand out in great unsymmetrical arches with axes running N. 30° E. to S. 30° W. One series of arches (anticlines) extends from Valley Mountain and South Branch Mountain just east of Greenspring toward the southwest along the South Branch of the Potomac, west

*The term Romney Shales has been used by the U. S. Geological Survey for the Marcellus, Hamilton, and Genesee Series combined, the Jennings for the Portage and Chemung, and the Hampshire for the Catskill, before any attempt had been made to correlate with the New York formations. Now that the correlation has been completed these names are now no longer recognized by the West Virginia Geological Survey.

FIGURE 8.—Map of Hampshire County showing Outcropping Rocks of Devonian Period. Figure prepared by Paul H. Price.

of Romney, to Mill Creek Mountain at the county line and beyond. Another series of arches extends southwesterly in parallel folds from the Morgan County line between the State line on the east and Cacapon River. In the southeastern part of the county the eastern part of the area is extended to Capon Springs, where Helderberg and Oriskany strata in the west limb of an anticline plunge into the ground to reappear repeatedly in the area as far west as North River.

Five sections of the various beds are to be seen along South Branch of Potomac River: southeast from Springfield, Grace, Wapocomo (The Rocks), Mechanicsburg, and Sector. Along North River good imposing sections lie a few miles south of Forks of Cacapon, and good outcrops of the Oriskany southeast of Capon Bridge.

The resistant character of these strata give emphasis to the range features of the county, which is but a portion of a larger range area of the Appalachian region.

HELDERBERG SERIES (MAP SYMBOL, Dhl).

KEYSER LIMESTONE.

This massive light-colored limestone extends from the distinctive Bossardville Limestone below to the shaly, noncherty Coeymans Limestone above. At Sector the thickness of this member is 50 feet.

Among the fossils, **Fenestella cumberlandica** and **Cladopora** are abundant and guide fossils to the formation. **Tentaculites gyracanthus** is characteristic of the higher portions of the Keyser beds, and **Stromatopora constellata** is often so abundant as to mark the location of old reefs.

Fossils of the Keyser Limestone.

(See statement preceding the List of Fossils of the Clinton Series).

Porifera
- Hindia sphaeroidalis Duncan 4

Coelenterata
- Zaphrentis keyserensis Swartz 4
- Cyathophyllum clarki Swartz 4
- Cyathophyllum inequale Hall 4
- Cyathophyllum schucherti Swartz 4
- Cyathophyllum marylandicum Swartz 4
- Heliophyllum cf. corniculum Lesueur 4
- Columnaria (?) helderbergiae Swartz 4
- Diphyphyllum integumentum 4
- Favosites helderbergiae Hall 1
- Favosites helderbergiae var. praecedens Schuchert 3, 4
- Favosites pyriformis Hall 4

Favosites conicus Hall 4
Favosites basalticus Goldfuss 4
Favosites favosus var. integritabulatus Swartz 4
*Cladopora rectilineata Simpson 1, 3, 4
Cladopora multiseriata Weller 3, 4
Aulopora schohariae Hall 3, 4
Aulopora schucherti Swartz 4
Ceratopora (?) marylandica Swartz 4
Halysites catenulatus Linne 4
*Stromatopora constellata Hall 1, 3, 4
Syringostroma barretti Girty 4
Syringostroma centrotum Girty 4
Vermipora serpuloides 3

Echinodermata
Camarocrinus stellatus Hall 4
Leptocrinus manlius Schuchert 4
Tetracystis chrysalis Schuchert 4
Jaekelocystis hartleyi Schuchert 4
Jaekelocystis papillatus Schuchert 4
Jaekelocystis avellana Schuchert 4
Pseudocrinites gordoni Schuchert 4
Pseudocrinites abnormalis Schuchert 4
Pseudocrinites stellatus Schuchert 4
Pseudocrinites clarki Schuchert 4
Pseudocrinites subquadratus Schuchert 4
Pseudocrinites elongatus Schuchert 4
Pseudocrinites perdewi Schuchert 4
Trimerocystis peculiaris Schuchert 4
Sphaerocystites multifasciatus Hall 4
Sphaerocystites globularis Schuchert 4
Sphaerocystites ovalis Schuchert 4

Vermes
Cornulites cingulatus Hall 4

Bryozoa
Rophalonaria attenuata Ulrich and Bassler 4
Ascodictyon siluriense Vine 4
Ceramopora (?) incondita Ulrich and Bassler 4
Fistulipora cumulata U. and B. 4
Fistuliporella quinquedentata U. and B. 4
Fistuliporella minima U. and B. 4
Fistuliporella marylandica U. and B. 4
Fistuliporella maynardi U. and B. 4
Chilotrypa micropora U. and B. 4
Cyphotrypa corrugata Weller 4
Batostomella interporosa U. and B. 4
Callotrypa parvulipora U. and B. 4
Lioclema subramosum U. and B. 3, 4
Lioclema pulchellum U. and B. 4
Stenopora (?) incrustans U. and B. 4
Diplostenopora siluriana Weller 4
Stromatotrypa globularis U. and B. 4
*Fenestella cumberlandica U. and B. 1, 2, 4
Fenestella (Cycloporina) altidorsata U. and B. 4
Polypora dictyota U. and B. 4
Semicoscinium planum U. and B. 4
Thamniscus regularis U. and B. 4
Orthopora rhombifera Hall (?) 4
Ptilodictya tenella U. and B. 4

Brachiopoda

Orbiculoidea schucherti Swartz 4
Pholidops tumida Schuchert 4
Pholidops ovata Hall 3, 4
Dalmanella clarki Maynard 4
Dalmanella concinna Hall 3, 4
Dalmanella postelegantula 3
Rhipidomella emarginata Hall 3, 4
Leptaena rhomboidalis Wilckens 3, 4
Stropheodonta varistriata Conrad 1, 3, 4
Stropheodonta bipartita Hall 3, 4
Stropheodonta bipartita var. nearpassi Barrett 4
Strophonella geniculata Hall 3, 4
Strophonella keyserensis Swartz 4
Schuchertella prolifica Schuchert 4
Schuchertella deformis Hall 4
Schuchertella sinuata Hall and Clarke 4
Schuchertella marylandica Maynard 4
Schuchertella deckerensis Weller 3, 4
Chonetes jerseyensis Weller 3, 4
Chonetes jerseyensis var. spinosus Maynard 4
Gypidula coeymanensis var. prognostica Schuchert 4
Gypidula coeymanensis var. corriganensis Maynard 4
Gypidula subglobosa Maynard 4
Stenochisma formosa Hall 4
Stenochisma deckerensis Weller 4
Camarotoechia litchfieldensis Schuchert 4
Camarotoechia (?) lamellata Hall 4
Camarotoechia gigantea Maynard 4
Uncinulus pyramidatus 3
Uncinulus mutabilis Hall 3
Uncinulus nucleolatus Hall 3, 4
Uncinulus nucleolatus var. angulatus Maynard 4
Uncinulus gordoni Maynard 4
Uncinulus keyserensis Schuchert 4
Uncinulus convexorus Maynard 4
Wilsonia globosa Weller 4
Rhynchonella formosa 3
Rhynchonella litchfieldensis Schuchert 3
Rhynchonella lamellata Hall 3
Rhynchonella transversa Hall 3
Rensselaeria mutabilis Hall 3, 4
Rensselaeria keyserensis Swartz 4
Rensselaeria (Beachia) proavita Schuchert 4
Atrypa reticularis Linnaeus 3, 4
Atrypa (?) biconvexa Maynard 4
Spirifer modestus Hall 3, 4
Spirifer modestus var. plicatus Maynard 4
Spirifer octocostatus Hall 3, 4
Spirifer vanuxemi Hall 3, 4
*Spirifer vanuxemi var. prognosticus Schuchert 4
Spirifer eriensis Grabau 3, 4
Reticularia bicostata Vanuxem 4
*Rhynchospira globosa Hall 3, 4
Nucleospira ventricosa Hall 4
Nucleospira elegans Hall 3, 4
Nucleospira swartzi Maynard 4
Anoplotheca concava var. tonolowayensis Swartz 4
Hindella (?) (Greenfieldia) congregata Swartz 4
Whitfieldella minuta Maynard 4

Whitfieldella nucleolata Hall 3, 4
Meristella praenuntia Schuchert 4
*Meristella arcuata Hall 3
Meristella laevis Vanuxem 3
Merista typa Hall 3, 4

Pelecypoda
Amphicoelia ulrichi Maynard 4
Actinopteria communis Hall 4
Actinopteria reticulata Weller 4
Aviculopecten tenuilamellatus Hall 4

Gastropoda
Bellerophon helderbergiae Swartz 4
*Bellerophon auriculatus Hall 4
Pleurotomaria labrosa Hall 4
Loxonema fitchi Hall 4
Conularia pyramidalis Hall 3
Platyostoma niagarense Hall 4
*Tentaculites gyracanthus Eaton 2, 3, 4

Cephalopoda
Orthoceras schucherti Maynard 4

Trilobita
Proetus pachydermatus Barrett 4
Calymene camerata Conrad 3, 4

Ostracoda
Leperditia altoides Weller 3, 4
Leperditia gigantea Weller 3, 4
Kloedenia kummeli Weller 3, 4
Kloedenia sussexensis Weller 3, 4
Kloedenia barretti Weller 3, 4
Kloedenella clarkei Jones 3
Kloedenella (Tetradella) hieroglyphica Krause 3
Kloedenella turgida Ulrich and Bassler 3
Kloedenella pennsylvanica Jones 3
Octonaria inaequalis U. and B. 4
Octonaria simplex Krause 4
Bythocypris arcuata U. and B. 4
Bythocypris punctulata var. arctatum U. and B. 4
Pontocypris arcuata U. and B. 4
Pontocypris mawii var. breviata Jones 4
Pachydomella longula U. and B. 4

COEYMANS LIMESTONE.

This shaly limestone, not cherty, lies between the heavy Keyser Limestone below and the thick cherty New Scotland Limestone above. At Sector the thickness of this member is 60 feet. At about a third of the length of the cliff from the northwest side of "The Rocks" north of Romney the Coeymans rises about ten feet above the talus.

The most distinctive fossils are **Gypidula coeymanensis** and **Spirifer cyclopterus.** Stems of **Lepocrinites** are abundant.

PLATE XIV.—"The Rocks", north of Romney. (See page 69 for description of plate).

DESCRIPTION OF PLATE XIV.—"The Rocks" north of Romney are a favorite resort. At the left of the low terrace in the foreground a camp is generally located during the summer. In the middle ground a short stretch of South Branch is visible where it turns to the left to pass high arches of Oriskany and Helderberg strata that rise like a wall along the narrow stretch occupied by the railroad and the highway.

Fossils of the Coeymans Limestone.

(See statement preceding the List of Fossils of the Clinton Series).

Coelenterata
- Favosites helderbergiae Hall 2, 4

Echinodermata
- Lepocrinites gebhardii Conrad 4

Bryozoa
- Lioclema subramosum Ulrich and Bassler 4

Brachiopoda
- Dalmanella perelegans Hall 4
- Rhipidomella oblata Hall 3, 4
- Leptaena rhomboidalis Wilckens 3, 4
- Leptaenisca concava Hall 4
- Stropheodonta coeymanensis Swartz 2, 4
- Stropheodonta arata Hall 4
- Stropheodonta planulata Hall 4
- Strophonella leavenworthana Hall 4
- Strophonella punctulifera Conard 3, 4
- Schuchertella woolworthana Hall 3, 4
- *Gypidula coeymanensis Schuchert 4
- Atrypa reticularis Linnaeus 3, 4
- *Spirifer cyclopterus Hall 3, 4
- Nucleospira ventricosa Hall 4
- Meristella laevis Vanuxem 3

Pelecypoda
- Actinopteria communis Hall 4

Gastropoda
- Tentaculites elongatus Hall 4

Cephalopoda
- Cyrtoceras (?) dubium Swartz 4

Trilobita
- Dalmanites (Hausmannia) pleuroptyx Green 4

NEW SCOTLAND CHERTY LIMESTONE.

The New Scotland is a thin-bedded, light-colored, cherty, fossiliferous limestone. The light color of the chert serves to distinguish it from the Shriver Chert above, which chert is dark. At Sector this limestone is 21 feet thick. At "The Rocks" it is 23 feet thick, where, at the northwest end of the cut, it dips northwest at an angle of 22° and passes beneath the level of the railroad track. To the southeast it flattens out and forms a conspicuous portion of the face of the cliff for more than half the length of the cut.

Spirifer macropleurus and Spirifer perlamellosus are guide fossils widely distributed.

Fossils of the New Scotland Cherty Limestone.

(See statement preceding the List of Fossils of the Clinton Series).

Porifera
- Hindia sphaeroidalis Duncan 4

Coelenterata
- *Streptelasma strictum Hall 4
- Favosites helderbergiae Hall 4
- Favosites conicus Hall 4
- Pleurodictyum lenticulare Hall 4
- Aulopora schucherti Swartz 4

Echinodermata
- Edriocrinus pocilliformis Hall 3, 4

Bryozoa
- Fistulipora maculosa Hall 4
- Chilotrypa constricta Hall 4
- Callotrypa macropora Hall 4
- Callotrypa striata Hall and Simpson 4
- Eridotrypa corticosa Hall 4
- Monotrypa sphaerica Hall 4
- Monotrypa tabulata Hall 3, 4
- Fenestella philia Hall 4
- Fenestella idalia Hall 4
- Polypora compacta Hall 4
- Semicoscinium coronis Hall 4
- Orthopora rhombifera Hall (?) 4
- Orthopora regularis Hall 4
- Orthopora ovatipora Hall 4
- Stictopora (?) papillosa Hall 4

Brachiopoda
- Orthostrophia strophomenoides Hall 4
- Dalmanella planiconvexa Hall 3, 4
- Dalmanella perelegans Hall 2, 3, 4
- Dalmanella eminens Hall 3, 4
- Rhipidomella oblata Hall 3, 4
- Leptaena rhomboidalis Wilckens 1, 2, 3, 4
- Leptaenisca concava Hall 4
- Schizophoria multistriata Hall 4
- Stropheodonta arata Hall 4
- Stropheodonta beckii Hall 2, 3, 4
- Stropheodonta planulata Hall 4
- Strophonella cavumbona Hall and Clarke 3
- Strophonella leavenworthana Hall 4
- Strophonella punctulifera Conrad 2, 3, 4
- Strophonella headleyana Hall 2, 3, 4
- Strophonella undaplicata Swartz 4
- Schuchertella prolifica Schuchert 4
- *Schuchertella woolworthana Hall 3, 4
- Schuchertella rugosa Swartz 1
- Chonetes subacutiradiatus Schuchert 4
- *Anoplia helderbergiae Schuchert 4
- Conostrophia helderbergiae Hall and Clarke 4
- Camarotoechia (?) altiplicata Hall 3
- Camarotoechia campbellana Hall 4
- Uncinulus mutabilis Hall 3
- Uncinulus vellicatus Hall 3, 4
- Uncinulus abruptus Hall 4
- Uncinulus gigantus Schuchert 4

Eatonia singularis Vanuxem 3, 4
Eatonia peculiaris Conrad 3, 4
Eatonia medialis Vanuxem 3, 4
Rhynchonella (?) bialveata Hall 4
Rensselaeria mutabilis Hall 3
Rensselaeria subglobosa Weller 2
Rensselaeria subglobosa var. avus Schuchert 4
Rensselaeria subglobosa var. crassa Schuchert 4
Atrypa reticularis Linnaeus 2, 3
Atrypina imbricata Hall 3, 4
*Spirifer macropleurus Conrad 1, 3, 4
*Spirifer perlamellosus Hall 1, 2, 3, 4
Spirifer cyclopterus Hall 3, 4
Spirifer concinnus Hall 2, 3
Spirifer gordoni Schuchert 2
*Ambocoelia umbonata Conrad (?) 4
Rhynchospira globosa Hall 4
Rhynchospira formosa Hall 2
Trematospira simplex Hall? 4
Trematospira multistriata Hall 3, 4
Trematospira deweyi Hall 3, 4
Trematospira equistriata Hall and Clarke 3, 4
Nucleospira ventricosa Hall 3, 4
Nucleospira elegans Hall 3, 4
Anoplotheca concava Hall 3, 4
Anoplotheca concava var. tonolowayensis Swartz 4
Anoplotheca (Leptocoelia) flabellites Conrad 3, 4
*Meristella arcuata Hall 1, 3, 4
Meristella subquadrata Schuchert and Maynard 3

Pelecypoda
Actinopteria communis Hall 4
Actinopteria textilis Hall 4
Cypricardinia sublamellosa Hall 4

Gastropoda
Pleurotomaria labrosa Hall 4
Platyceras gebhardi Conrad 3, 4
Platyceras reflexum Hall 4
Platyceras trilobatum Hall? 3, 4
Platyceras multisinuatum Hall 4
Platyceras spirale Hall 3, 4
Diaphorostoma ventricosum Conrad 4
Diaphorostoma depressum Hall 4
Tentaculites elongatus Hall 4

Trilobita
Proetus protuberans Hall 4
Phacops logani Hall 1, 4
Dalmanites (Hausmannia) pleuroptyx Green 4

ORISKANY SERIES (MAP SYMBOL, Do).

SHRIVER CHERT.

The basal part of the Oriskany Series is the Shriver Chert. This chert is distinguished from the light-colored chert of the New Scotland below it by the dark appearance of the Shriver Chert. In the upper portion the chert becomes more arenaceous, approaching in character that of the

PLATE XV.—The upper portion in the picture is New Scotland Chert, at "The Rocks" near Romney.

base of the Ridgeley Sandstone. West of Sector it appears to be 89 feet thick, and at the northwestern part of the cut at "The Rocks" north of Romney it is 203 feet thick.

Characteristic fossils are as follows:

Anoplotheca flabellites Conrad
Anoplia nucleata Hall
Rensselaeria (Beachia) suessana Hall
Pholidops multilamellosa Schuchert
Spirifer tribulis Hall
Spirifer paucicostatus Schuchert
Stropheodonta arctimuscula Schuchert and Maynard
Tentaculites aculus Hall.

RIDGELEY SANDSTONE.

The upper portion of the Oriskany is a distinct siliceous sandstone, sometimes white and sometimes reddish brown, known as the Ridgeley Sandstone. The lower portion grades into a calcareous sandstone with no plane of separation present between the non-calcareous sandstone above and the calcareous phase below which grades on into the Shriver Chert. Just west of Sector it appears to be 94 feet thick. At the northwest end of the cliff at "The Rocks" its thickness is found to be 170 feet. At the southeast end of the cliff the combined thickness of Ridgeley Sandstone and Shriver Chert is 382 feet.

There are extensive beds of casts and impressions of the guide fossils **Spirifer arenosus** and **Hipparionyx proximus**, especially in the upper portion of the deposit. In all cases the original calcareous material has been dissolved out. In some places there has been replacement by silica. This upper portion has the distinctive brownish character of "Oriskany Sandstone". Characteristic fossils are as follows:

Eatonia sinuata Hall
Hipparionyx proximus Vanuxem
Rensselaeria (Beachia) suessana Hall
Spirifer arenosus Conrad
Spirifer cumberlandiae Hall
Spirifer intermedius Hall
Spirifer murchisoni Castelnau
Spirifer concinnoideus Schuchert and Maynard.

DESCRIPTION OF PLATE I.—(Frontispiece).—Caudy's Castle from the riverside looking a little west of north, revealing bedding-planes dipping steeply to the west edge of Cacapon River. On the opposite side of the valley a cliff equally steep bounds the valley for about a mile, while between these two cliffs is a low anticline of the same Oriskany Sandstone mostly concealed along the valley floor but very well exposed at one point perhaps half a mile farther up the valley. Caudy's Castle is noted as the place where Caudy took refuge from the Indians during the depredations of the French and Indian War. The top of the cliff is accessible along a narrow path that winds its way from the opposite side of the column of rocks and then along the steep face over the river where from a distance it looks as if there were no footing. Here what is left of the Oriskany Sandstone curves over and downward to beneath the river. The sandstone is white, composed of fine rounded pebbles of quartz, easily crushed into a fine white sand—an excellent glass-sand. Only the surface is stained yellowish by the hydrated oxide of iron that has been leached from the stone and deposited at the surface as the water evaporated. The ground around the cliff contains an abundance of fine white sand.

Fossils of the Oriskany Series.

(See statement preceding the List of Fossils of the Clinton Series).

Coelenterata
- Zaphrentis roemeri Milne-Edwards and Haime 4
- Favosites conicus Hall 4
- Favosites (?) schriveri Herzer 4
- Striatopora bella Swartz 4
- Aulopora schucherti Swartz 4

Echinodermata
- Anomalocystites disparilis Hall (?) 4
- Thysanocrinus eugenius Ohern 4
- Technocrinus sculptus Hall 4
- Technocrinus striatus Hall 4
- Technocrinus andrewsi Hall 4
- Technocrinus spinulosus Hall 4
- Technocrinus lepidus Ohern 4
- Calceocrinus marylandicus Ohern 4
- Homocrinus proboscidalis Hall 4
- Homocrinus hartleyi Ohern 4
- Edriocrinus sacculus Hall 4

Brachiopoda
- Orbiculoidea roederi Schuchert 4
- Orbiculoidea ampla Hall 4
- Pholidops multilamellosa Schuchert 4
- Lingulapholis terminalis Hall 4
- Rhipidomella musculosa Hall 2, 3, 4
- Rhipidomella musculosa var. arctisinuata Schuchert 4
- Rhipidomella marylandica Schuchert 4
- Leptaena rhomboidalis var. ventricosa Hall 4
- Schizophoria oriskania Schuchert 4
- Stropheodonta lincklaeni Hall 3
- Stropheodonta demissa Conrad 4
- Stropheodonta magnifica Hall 2, 3
- Stropheodonta magniventra Hall 4
- Schuchertella becraftensis Hall and Clarke 4
- *Hipparionyx proximus Vanuxem 1, 2, 3, 4
- Chonetes rowei Schuchert 4
- Chonetes hudsonicus Clarke 4
- Chonostrophia complanata Hall 3, 4
- Anoplia nucleata Hall 3
- Stenochisma lamellata Hall 2, 4
- Rhynchotreta cumberlandica Rowe 4
- Camarotoechia speciosa Hall 4
- Camarotoechia speciosa var. ramsayi Hall 4
- Camarotoechia barrandii Hall 3, 4
- Camarotoechia barrandii var. fitchana Hall 4
- Camarotoechia pleiopleura Conrad 4

PLATE XVI.—View from South Branch of Potomac beneath the south end of the bridge at Grace. (See page 78 for description of plate).

PLATE XVII.—Cliff east of Caudy's Castle. (See page 79 for description of plate).

Camarotoechia oriskania Rowe 4
Eatonia whitfieldi Hall 4
Eatonia medialis Vanuxem 4
*Eatonia sinuata Hall 4
Eatonia hartleyi Schuchert 4
Rensselaeria circularis Schuchert 2, 4
Rensselaeria marylandica Hall 4
Rensselaeria marylandica var. symmetrica Schuchert 4
Rensselaeria ovoides Castelnau 3
Rensselaeria keyserensis Swartz 2
Rensselaeria (Beachia) cumberlandiae Hall 4
*Rensselaeria (Beachia) suessana Hall 4
Rensselaeria (Beachia) suessana var. immatura Schuchert 1, 4
Rensselaeria (Beachia) ovalis Hall 4
Megalanteris ovalis Hall and Clarke 3
Oriskania (?) lucerna Schuchert 4
Tropidoleptus carinatus Conrad 4
Atrypa reticularis Linnaeus 4
*Spirifer cumberlandiae Hall 3, 4
Spirifer paucicostatus Schuchert 4
Spirifer tribulis Hall 3, 4
Spirifer angularis Schuchert 4
*Spirifer intermedius Hall 1, 4
Spirifer medialis Hall 2
*Spirifer murchisoni Castelnau 3, 4
Spirifer murchisoni var. marylandicus Schuchert 4
Spirifer hartleyi Schuchert 3, 4
Spirifer perdewi Schuchert 4
Spirifer tribuarius Schuchert 4
*Spirifer arenosus Conrad 4
*Spirifer concinnoideus Schuchert 4
Spirifer gordoni Schuchert 4
Metaplasia pyxidata Hall 4
Cyrtina rostrata Hall 4
Rhynchospira rectirostris Hall 4
Leptocoelia flabellites Conrad 3
Anoplotheca equistriata Schuchert 4
Anoplotheca dichotoma Hall 4
Anoplotheca (Leptocoelia) fimbriata Hall 4
Anoplotheca (Leptocoelia) flabellites Conrad 4
Meristella lata Hall 3
Meristella lentiformis Clarke 4
Meristella laevis Vanuxem 4
Meristella rostellata Schuchert 4
Meristella symmetrica Schuchert 4

Pelecypoda
Pterinea halli Clarke 4
Mytilarca (Plethomytilis) rowei Ohern 4
Palaeopinna lata Ohern 4
Actinopteria communis Hall 4
Actinopteria textilis var. arenaria Hall 4
Actinopteria virginica Ohern 4
Avicula recticosta Hall (?) 4
Avicula textilis var. arenaria Hall 3
Megambonia lamellosa Hall 4

Gastropoda
Cyrtolites expansus Hall 4
Orthonychia tortuosa Hall 4
Platyceras nodosum Conrad 4

Platyceras gebhardi Conrad 2, 3, 4
Platyceras gebhardi var. ventricosum Conrad 4
Platyceras magnificum Hall 4
Platyceras subfalcatum Ohern 4
Platyceras patulum Hall 4
Platyceras reflexum Hall 4
Platyceras (?) callosum Hall 4
Platyceras sinuatum Hall (?) 4
Platyceras angulare Rowe 4
Platyceras platystomum Hall (?) 4
Platyceras gracile Ohern 4
Platyceras subconicum Ohern 4
Platyceras newberryi Hall 4
Strophostylus matheri Hall 4
Strophostylus transversus Hall 4
Strophostylus andrewsi Hall 4
Diaphorostoma ventricosum Conrad 3, 4
Diaphorostoma desmatum Clarke 4
Tentaculites aculus Hall 4
Tentaculites elongatus Hall 2, 3, 4

Trilobita
Homalonotus swartzi Ohern 4
Homalonotus vanuxemi Hall 4
Dalmanites micrurus Green 4
Dalmanites multiannulatus Ohern 4
Dalmanites latus Ohern 4
Dalmanites (Synphoria) stemmatus Clarke 4
Dalmanites (Corycephalus) dentatus Barrett (?) 4
Dalmanites (Chasmops) anchiops Green 4
Dalmanites berkleyensis Swartz 4

Ostracoda
Primitia postturgida Ulrich and Bassler 4
Primitia concentrica U. and B. 4
Primitiella variolata U. and B. 4
Ulrichia aequalis U. and B. 4
Bollia americana U. and B. 4
Bollia curta U. and B. 4
Bollia jugalis U. and B. 4
Bollia ungula Jones 4
Thlipsura multipunctata U. and B. 4
Craterellina oblonga U. and B. 4
Craterellina robusta U. and B. 4

DESCRIPTION OF PLATE XVI.—View from the river beneath the south end of the bridge at Grace. At Grace the South Branch of the Potomac crosses an arch of resistant strata from one shaly valley to another. At some previous time the valley surface lay across this ridge but at a higher level than the resistant sandstone. At that time the Schooley Peneplain marked the level of the country. As the uplift proceeded the river cut its way deeper and deeper into the underlying rock, finding here and there joints in the rocks that favored stream erosion. All through the stages of uplift marked by the Harrisburg Peneplain and by the other terraces along the valleys, the river washed along the loose weathered material and scoured its trench until now we see a river that apparently cuts through a mountain of resistant rock from one valley to another in both of which the drainage is well adjusted to the structure. This is a characteristic feature in the Appalachian trellis arrangement of the rivers.

DESCRIPTION OF PLATE XVII.—On the opposite side of Cacapon River from Caudy's Castle, the bed of Oriskany Sandstone which dips so steeply beneath the river at Caudy's Castle rises again as a high cliff that stretches for a mile along the river, the smooth surface of the cliff scarcely broken by a scanty growth of vegetation.

MIDDLE DEVONIAN.

The Middle Devonian includes the Marcellus Series below and the Hamilton Series above. The lower of these two includes the Selinsgrove Shale at the base, above which comes the Selinsgrove Limestone (Onondaga), above which is the Marcellus Shale. No Upper Selinsgrove Limestone has been recognized in the area. The Middle Devonian strata are yielding members between the arches of Lower Devonian strata, and, because of more rapid erosion of such shale, become the areas of valleys and low hills stretching southwest from Greenspring to Springfield, and then along the South Branch of the Potomac to Sector, two miles west of which is a parallel valley in an area of Marcellus Shale. In the eastern part of the county another broad valley in Marcellus Shale is drained by the Cacapon River. West of North River Mountain the Marcellus and Hamilton strata dip so steeply to the northwest that they are not conspicuous valley makers in that region.

MARCELLUS SERIES (MAP SYMBOL, Dm).

This series is a dark concretionary generally non-fossiliferous shale extending from the Ridgeley (Oriskany) Sandstone below to the fossiliferous Hamilton Shale above. Large dark concretions are common. In places it is so dark that it has been dug into for coal, but no coal horizons exist in the Marcellus Shale.

The Selinsgrove Shale in the base of the Marcellus Series is about 75 feet thick. Above this is the (Lower) Selinsgrove Limestone* which is 9.5 feet thick and divided into four principal layers. (There is here no Upper Selinsgrove Limestone). It is almost impossible to obtain a good determination of the thickness of the Marcellus Series. It is a weak member, crushed and crumpled, and even overturned, between masses of resistant Lower Devonian limestone and sandstone.

*E. M. Kindle has traced this fossiliferous horizon from Pennsylvania to Tennessee. Bull. No. 508, U. S. Geological Survey.

The Marcellus Series is not generally fossiliferous, but one locality having been found where fossils are abundant. As **Liorhynchus limitare** has been found in both the Selinsgrove Shale as well as in the shale above the Selinsgrove Limestone, there seems to be no good reason for recognizing the basal portions as distinctive Onondaga, even though **Anoplotheca acutiplicata** is also found in this basal portion in exposures along the south bank of the Potomac east of Greenspring and by the roadside at Springfield. In the upper portion of the Marcellus Shale, **Liorhynchus mysia, Liorhynchus limitare, Chonetes coronatus,** and **Styliolina fissurella** are occasionally found. The following have been found in the lower portion of the Marcellus Series:

Ambocoelia virginiana Prosser
Atrypa reticularis Linne
Chonetes coronatus Conrad
Liorhynchus limitare Vanuxem
Liorhynchus mysia Hall
Buchiola halli Clarke
Aviculopecten princeps Conrad
Nucula bellistriata Conrad
Nuculites oblongatus Conrad
Styliolina fissurella Hall
Tentaculites bellulus Hall
Phacops rana Green.

Fossils of the Marcellus Series.

(See statement preceding the List of Fossils of the Clinton Series).

Coelenterata
- Stereolasma rectum Hall 1, 2, 4

Brachiopoda
- Lingula cf. nuda Hall 4
- Craniella hamiltoniae Hall 3, 4
- Pholidops cf. areolata Hall 3
- Dalmanella lenticularis Vanuxem 3, 4
- Rhipidomella vanuxemi Hall 3, 4
- Rhipidomella cyclas Hall (?) 4
- Stropheodonta perplana Conrad 3
- Pholidostrophia pennsylvanica Kindle 4
- Leptaenisca australis Kindle 4
- Schuchertella variabilis Prosser 4
- Chonetes mucronatus Hall 3, 4
- Chonetes coronatus Conrad 4
- Chonetes lepidus Hall 3
- Chonetes scitulus Hall 2, 3
- Chonetes rugosus Kindle 4
- Anoplia nucleata Hall 2, 3, 4
- Anoplia helderbergiae Schuchert 1
- Stropholosia truncata Hall 3, 4
- Camarotoechia prolifica Hall 3, 4
- *Liorhynchus limitare Vanuxem 1, 2, 3, 4
- Liorhynchus laura Billings 2

PLATE XVIII.—Contact between the Onondaga (above) and the Oriskany below in a ravine along the east side of Valley Mountain, near the North Branch.

*Liorhynchus mysia Hall 4
Centronella ovata Hall 4
Tropidoleptus carinatus Conrad 2, 3
Cryptonella eudora Hall 2
Atrypa spinosa Hall 2
Spirifer (Reticularia) fimbriatus Conrad 4
Ambocoelia umbonata Conrad (?) 2, 3
Ambocoelia virginiana Prosser 1, 4
Crytina hamiltonensis Hall 3
Nucleospira concinna Hall 3, 4
*Anoplotheca (Coelospira) acutiplicata Conrad 2, 4
Anoplotheca camilla Hall 4

Pelecypoda
Panenka alternata Hall 4
Panenka dichotoma Hall 4
Panenka obsolescens Kindle 4
Panenka multiradiata Hall 4
Buchiola halli Clarke 1, 2
Nucula corbuliformis Hall 2, 3, 4
Nuculites triquiter Conrad 3, 4
Nuculites modulatus Kindle 4
Palaeoneilo constricta Conrad 4
Liopteria laevis Hall 4
Aviculopecten equilatera Hall 4
Modiomorpha subalata Conrad 4

Gastropoda
Loxonema hamiltoniae Hall 2, 4
Platyostoma euomphalus Conrad 4
*Styliolina fissurella Hall 4
Conularia undulata Conrad 2, 4
Coleolus tenuicinctus Hall 2

Cephalopoda
Orthoceras subulatum Hall (?) 2
Orthoceras scitula Hall 2
Spyroceras crotalum Hall 2
Bactrites aciculatus Hall 4
Bactrites aciculus Hall 2, 4
Agoniatites expansus Vanuxem 4
Parodiceras discoideum Conrad 2, 4
Probeloceras lutheri Clarke (?) 2

Trilobita
Cyphaspis cf. stephanophora Hall 4
Phacops cristata Hall 4
Phacops cristata var. pipa Hall 4

Ostracoda
Leperditia (?) cf. subrotunda Ulrich 4
Bollia ungula Jones 4
Bollia obesa Ulrich 4

HAMILTON SERIES (MAP SYMBOL, Dhm).

This is a dark, very fossiliferous shale extending from the dark concretionary shale below to the dark and generally non-fossiliferous Genesee Shale above. The thickness found east of French is 265 feet.

Fossils of various kinds are numerous in the Hamilton Shale, particularly in the topmost portion where beds of

Spirifer mucronatus are wide-spread. **Ambocoelia umbonata** and **Tropidoleptus carinatus** are almost index fossils, though they are also to be found below and above this horizon.

Fossils of the Hamilton Series.

(See statement preceding the List of Fossils of the Clinton Series).

Coelenterata
- Stereolasma rectum Hall 1, 4
- Heliophyllum confluens Hall 2
- Heliophyllum halli Milne-Edwards and Haime 2
- Cystiphyllum americanum Milne-Edwards and Haime 1, 4
- Favosites gothlandicus Goldfuss 2

Bryozoa
- Ropalonaria tenuis Ulrich and Bassler 4
- *Monticulipora (?) marylandensis U. and B. 4

Brachiopoda
- Lingulella (?) paliformis Hall 4
- Lingula delia Hall (?) 4
- Lingula ligea Hall (?) 4
- Lingula cf. compta Hall and Clarke 4
- Lingula clarki Prouty 4
- Orbiculoidea lodiensis var. media Hall 4
- Craniella hamiltoniae Hall 4
- Pholidops hamiltoniae Hall 4
- Stropheodonta concava Hall 3, 4
- Stropheodonta inaequistriata Conrad 2, 4
- Stropheodonta perplana Conrad 2, 4
- Stropheodonta demissa Conrad 3, 4
- Leptaena rhomboidalis Wilckens 4
- Chonetes mucronatus Hall 2, 3, 4
- *Chonetes marylandicus Ulrich and Bassler 1, 4
- Chonetes vicinus Castelnau 2, 3, 4
- Chonetes lepidus Hall 2, 4
- Chonetes scitulus Hall 4
- Chonetes setiger Hall 3, 4
- *Chonetes coronatus Conrad 2, 3, 4
- Productella schucherti Prosser 4
- Productella cf. spinulicosta Hall 4
- Rhipidomella vanuxemi Hall 3, 4
- Rhipidomella leucosia Hall 2, 4
- Rhipidomella penelope Hall 2, 3, 4
- Rhipidomella cyclas Hall (?) 4
- Schizophoria striatula Schlotheim (?) 4
- Schizophoria striatula var. marylandica Clarke and Swartz 2, 4
- Strophalosia truncata Hall 4
- Camarotoechia prolifica Hall 2, 3, 4
- Camarotoechia sappho Hall 4
- Liorhynchus laura Billings 4
- Eunella lincklaeni Hall 4
- *Tropidoleptus carinatus Conrad 1, 4
- Crytina hamiltonensis Hall 4
- Atrypa reticularis Linnaeus 2, 4
- Atrypa spinosa Hall 2
- Spirifer fimbriatus Hall 2, 4
- *Spirifer mucronatus Conrad 1, 2, 3, 4
- *Spirifer granulosus Conrad, 1, 3, 4
- Spirifer audaculus Conrad 4

Spirifer acuminatus Conrad 4
Spirifer tullius Hall 3, 4
Spirifer angustus Hall 4
Spirifer consobrinus d'Orbigny 2, 4
*Spirifer sculptilis var. marylandensis Prosser 4
Reticularia fimbriata Schuchert 3
*Ambocoelia umbonata Conrad (?) 2, 4
Ambocoelia praeumbona Hall (?) 4
Nucleospira concinna Hall 3, 4
Anoplotheca (Coelospira) acutiplicata Conrad 4
Vitulina pustulosa Hall 4
*Athyris spiriferoides Eaton 1, 2, 3, 4

Pelecypoda

Phthonia sectifrona Conrad 4
Phthonia lanceolata Hall 3, 4
Orthonota undulata Conrad 4
Orthonota (?) parvula Hall 4
Grammysia bisculcata Conrad 3, 4
Grammysia arcuata Conrad 4
Grammysia circularis Hall (?) 4
Tellinopsis subemarginata Conrad 4
Buchiola halli Clarke 4
Nucula corbuliformis Hall 1, 4
*Nucula bellistriata Conrad 2, 4
Nucula lirata Conrad 4
Nucula varicosa Hall 4
Nuculites oblongatus Conrad 4
*Nuculites triqueter Conrad 4
Nuculites grabaui Prosser 1, 4
Palaeoneilo plana Hall 4
Palaeoneilo maxima Conrad (?) 4
Palaeoneilo fecunda Hall 4
Palaeoneilo perplana var. grabaui Prosser 4
Palaeoneilo emarginata Conrad 2, 4
*Palaeoneilo tenuistriata Hall (?) 1, 4
Palaeoneilo clarkei Prosser 4
Palaeoneilo constricta Conrad 3, 4
Palaeoneilo rowei Prosser 4
Palaeoneilo marylandica Prosser 4
Tancrediopsis clarkei Prosser 4
Leda diversa Hall 4
Leda rostellata Conrad 4
Parallelodon hamiltoniae Hall 4
Leptodesma rogersi Hall 4
Pterinea flabellum Conrad 4
Liopteria conradi Hall 4
Conocardium cumberlandiae Swartz 4
Conocardium normale Hall 4
Actinopteria decussata Hall 2, 4
Actinopteria boydi var. gibbosa Prosser 4
Modiella pygmaea Conrad 4
Mytilarca oviformis Conrad 4
Nyassa arguta Hall (?) 4
*Aviculopecten princeps Conrad 1, 4
Modiomorpha concentrica Conrad 4
Modiomorpha subalata Conrad 4
Modiomorpha mytiloides Conrad (?) 4
Goniophora hamiltonensis Hall 4
Pholadella radiata Conrad 4
Cypricardella bellistriata Conrad 3, 4

Cypricardella tenuistriata Hall 4
Cypricardinia indenta Conrad 4
Paracyclas lirata Conrad 3, 4
Paracyclas tenuis Hall 4
Palaeosolen minutus Prosser 4

Gastropoda

Pleurotomaria (Bembexia) sulcomarginata Conrad 4
Pleurotomaria (Gyroma) capillaria Conrad 3, 4
Pleurotomaria (Trepospira) rotalia Hall 4
Pleurotomaria (Euryzone) itys Hall (?) 4
Bellerophon (Bucanopsis) leda Hall 4
Bellerophon (Patellostium) patulus Hall (?) 4
Cyrtolites (Cyrtonella) mitella Hall 4
Cyclonema hamiltoniae Hall (?) 4
Cyclonema liratum var. grabaui Prosser 4
Cyclonema (?) marylandense Prosser 4
*Macrochilus hamiltoniae Hall 1, 4
Loxonema hamiltoniae Hall 2, 4
Platyceras erectum Hall (?) 4
Platyceras symmetricum Hall 4
Diaphorostoma lineatum Conrad 4
Diaphorostoma niagarense Hall 2
Styliolina fissurella Hall 3, 4
Coleolus tenuicinctus Hall 3
Tentaculites attenuatus Hall 4
Tentaculites bellulus Hall 4
Tentaculites bellulus var. potomacensis Prosser 4

Cephalopoda

Orthoceras bebryx Hall (?) 4
Orthoceras subulatum Hall (?) 2, 4
Orthoceras constrictum Vanuxem 4
Orthoceras exile Hall 4
Orthoceras telamon Hall (?) 4
Orthoceras emaceratum Hall (?) 4
Orthoceras aulax Hall 4
Spyroceras crotalum Hall 4
Spyroceras nuntium Hall 4
Spyroceras clarkei Prosser 4
Gomphoceras pingue Hall 4
Bactrites aciculus Hall 4

Trilobita

Homalonotus dekayi Green 3, 4
Phacops rana Green 1, 2, 3, 4
Dalmanites (Cryphaeus) boothi Green 2, 4
Dalmanites marylandicus Prosser 4

UPPER DEVONIAN.

The Upper Devonian includes the following series:

Catskill Series,
Chemung Series,
Portage Series,
Genesee Series (at the base).

As a whole the Upper Devonian strata reveal a gradation from greenish shales with gray sandstone at the base, through gray sandy shale and conglomerates, all of shallow-water marine strata rich in fossils in places; though where

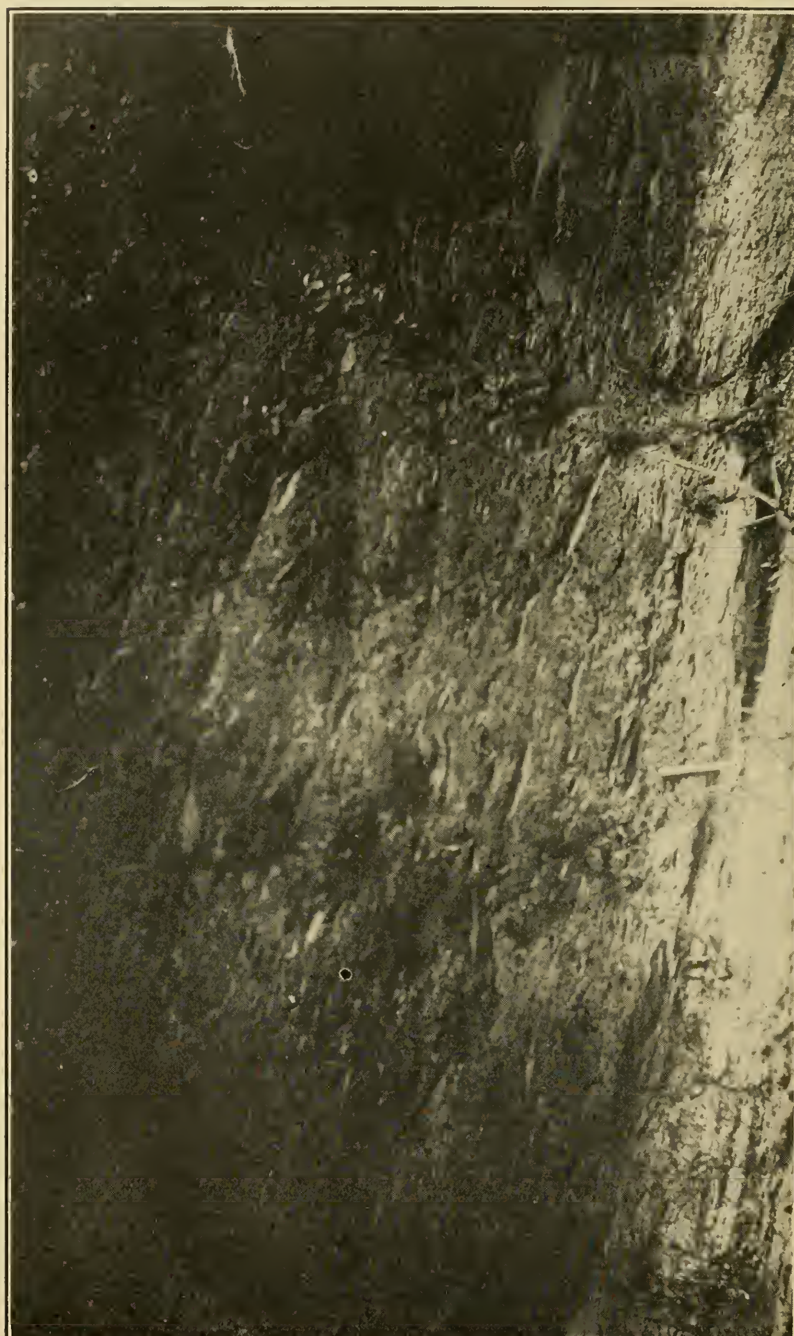

PLATE XIX.—Contact between Hamilton below and Genesee above, two miles west of Greenspring. The hammer rests on a coral reef.

reddish, the shales and sandstones are of distinctly subaerial character and rarely fossiliferous.

In the previous description, the Marcellus was described as a mass of shale stretching northeast-southwest along the main rivers in the central part of the county, a region which with its many folds is essentially synclinal (bent down). Along the axes of these synclinal areas are the higher strata of the Upper Devonian, their more resistant portions rising above the softer strata. To the southeast of the broad synclinal area through the county rise the folds (anticlines) in which deeper resistant strata of Oriskany and Medina Sandstones form the mountain tops, as in Ice Mountain, Cacapon Mountain, North River Mountain, and farther still to the southeast, Bear Garden and North Mountains, from the crests of which the later strata have been eroded away. Likewise to the west of the broad central synclinal area lie the South Branch and Valley Mountains with lower strata exposed along their crests, from which toward the east there is the same sequence of strata as that found toward the west from Cacapon, North, North River, and Ice Mountains. It is in the centers of these synclinal mountains that patches of the next overlying system of strata (Pocono) are to be found. Where on each side of these synclinal areas the strata rise to the surface the resistant strata stand out in ridges, while between them the less resistant strata are cut into by erosion. Thus the shaly Genesee and Portage combine with the Marcellus and Hamilton to mark the valleys, while the sandstones and conglomerates of the Chemung form ridges, and the shaly Catskill forms rounded mountain tops.

GENESEE SERIES (MAP SYMBOL, Dg).

This series is a dark argillaceous shale extending from the fossiliferous Hamilton below to the lighter-colored argillaceous shale above. West of Greenspring its thickness is 300 feet. A partial thickness near the town of Junction is 129 feet, and a partial thickness west of Mechanicsburg is 154 feet.

The series is in general not very fossiliferous, but **Buchiola retrostriata** is occasionally found, and **Styliolina fissurella** is occasionally abundant, also **Paracardium doris** and **Pterochaenia fragilis.** **Tornoceras uniangulare** is considered a guide fossil.

Fossils of the Genesee Series.

(See statement preceding the List of Fossils of the Clinton Series).

Brachiopoda
- Lingula spatulata Vanuxem 1

Pelecypoda
- Buchiola conversa Clarke 3
- *Buchiola retrostriata von Buch 2, 3, 4
- Buchiola livoniae Clarke 2, 3, 4
- Buchiola mariae Clarke and Swartz 4
- *Paracardium doris Hall 1, 2, 4
- Paracardium delicatulum Clarke 4
- *Pterochaenia fragilis Hall 1, 2, 3, 4
- Lunulicardium cymbula Clarke and Swartz 4
- Lunulicardium encrinitum Clarke 4

Gastropoda
- *Styliolina fissurella Hall 1, 2, 3, 4
- Pharetrella tenebrosa Hall 4

Cephalopoda
- Orthoceras filosum Hall 3, 4
- Bactrites aciculus Hall 1, 2, 3, 4
- *Tornoceras uniangulare Conrad 1, 3, 4
- Probeloceras lutheri Clarke (?) 2, 3, 4

PORTAGE SERIES (MAP SYMBOL, Dp).

This is an argillaceous shale, often greenish in color. The series contains many thin beds of fine-grained grayish sandstone, but no bed approaching two feet in thickness, and no conglomerate. The series extends from the dark Genesee Shale below to the conglomerate at the base of the Chemung above. In the Maryland Survey, the series is divided into two parts, a Woodmont below and a Parkhead above. Along Big Run east of Romney the thickness is found to be 1268 feet, the strata outcropping from back of the School for the Deaf and Blind to a point up the ravine about one hundred yards west of the cement bridge where the Northwestern Pike crosses the ravine. Fossils are not abundant, though the entire list reported is considerable. In the lower portion the following are characteristic: **Liorhynchus globuliforme, Reticularia laevis**, and **Spirifer mucronatus var. posterus.** In the upper portion the following are characteristic: **Camarotoechia congregata var. parkheadensis, Liorhynchus mesacostale, Tropidoleptus carinatus, Spirifer mesacostalis, Leptodesma naviforme, Cyclonemina multistriata.**

Fossils of the Portage Series.

(See statement preceding the List of Fossils of the Clinton Series).

Coelenterata
- Aulopora repens Knorr and Welch 4
- Cladochonus humilis Clarke and Swartz 3, 4

Vermes
    Pteridichnites biseriatus Clarke and Swartz 4
Brachiopoda
    Lingula oherni Clarke and Swartz 4
    Lingula spatulata Vanuxem 4
    Lingula ligea Hall (?) 4
    Orbiculoidea media Hall 4
    Craniella hamiltoniae Hall 4
    Rhipidomella vanuxemi Hall 4
    Schizophoria striatula Schlotheim (?) 4
    Stropheodonta demissa Conrad 4
    Leptostrophia interstrialis Vanuxem 4
    Chonetes rowei Schuchert 4
    Chonetes lepidiformis Clarke and Swartz 4
    Productella lachrymosa Conrad 3, 4
    Productella speciosa Hall 3, 4
    Productella navicelliformis Clarke and Swartz 4
    Camarotoechia eximia Hall 4
    Camarotoechia congregata Conrad 4
    *Camarotoechia congregata var. parkheadensis Clarke and Swartz 3, 4
    Camarotoechia horsfordi Hall 4
    Liorhynchus multicostum Hall 4
    *Liorhynchus globuliforme Vanuxem 4
    *Liorhynchus mesacostale Hall 4
    *Tropidoleptus carinatus Conrad 3, 4
    Pugnax pugnus var. altus Calvin 3, 4
    *Reticularia laevis Hall 3, 4
    Atrypa reticularis Linnaeus 4
    Atrypa spinosa Hall 4
    Cyrtina hamiltonensis Hall 4
    *Spirifer mesacostalis Hall 4
    *Spirifer mucronatus var. posterus Hall and Clarke 4
    Spirifer mesastrialis Hall 4
    Ambocoelia umbonata Conrad (?) 3, 4
    Meristella humilis Clarke and Swartz 4
Pelecypoda
    Grammysia elliptica Hall 4
    Grammysia communis Hall 4
    Grammysia subarcuata Hall 4
    Buchiola retrostriata von Buch 4
    Buchiola livoniae Clarke 4
    Nucula corbuliformis Hall 4
    Paracardium doris Hall 4
    Palaeoneilo plana Hall 4
    Palaeoneilo maxima Conrad (?) 4
    Palaeoneilo petila Clarke 4
    Palaeoneilo constricta Conrad 4
    Palaeoneilo brevis Hall 4
    Leda diversa Hall 4
    Macrodon chemungensis Hall 4
    *Leptodesma naviforme Hall 4
    Ectenodesma birostratum Hall 3, 4
    Liopteria bigsbyi Hall 4
    Liopteria auriculata Clarke and Swartz 4
    Actinopteria boydi var. gibbosa Prosser 4
    Schizodus oherni Clarke and Swartz 4
    Schizodus trigonalis Clarke and Swartz 4
    Aviculopecten cancellatus Hall 4
    Goniophora glauca Hall 4

Goniophora hamiltonensis Hall 4
Goniophora truncata Hall 4
Cypricardella bellistriata Conrad 3, 4
Cypricardella tenuistriata Hall 4
Cypricardella gregaria Hall 4

Gastropoda
Pleurotomaria (Gyroma) capillaria Conrad 4
Bellerophon clarki Clarke and Swartz 4
Bellerophon nactoides Clarke and Swartz 4
Bucanopsis maera Conrad 4
Stroparollus marylandicus Clarke and Swartz 4
Hormotoma gracilis Hall 4
Hormotoma bistriata Clarke and Swartz 4
Ectomaria marylandica Clarke and Swartz 4
Phanerotinus laxus Hall 4
Cyclonema concinnum Hall 4
*Cyclonemina multistriata Prosser and Kindle 4
Loxonema glabrum Prosser and Kindle 4
Loxonema hamiltoniae Hall 4
Holopea rowei Clarke and Swartz 4
Holopea humilis Clarke and Swartz 4
Orthonychia unguiculata Clarke and Swartz 4
Platyceras marylandicum Clarke and Swartz 4
Diaphorostoma lineatum Conrad 4
Coleolus tenuicinctus Hall 4
Tentaculites spiculus Hall 4
Hyolithes aclis Hall 4

Cephalopoda
Orthoceras demum Hall 4
Orthoceras filosum Clarke 4
Manticoceras patersoni Hall 4
Probeloceras lutheri Clarke (?) 4
Sandbergeroceras chemungensis Vanuxem 4

Trilobita
Phacops rana Green 4

CHEMUNG SERIES (MAP SYMBOL, Dch).

The Chemung Series consists of a grayish arenaceous shale with numerous beds of gray sandstone some of which are two feet thick. Many layers show ripple-marks. Its base is a conglomerate immediately above the Portage Series, and its top is at the top of the Hendricks Conglomerate and Sandstone with its flattish pebbles, just above the lowermost beds of red shale. In the section along Big Run east of Romney, the thickness of the Chemung was found to be 1214 feet, beginning at the base of the conglomerate about a hundred yards west of the cement bridge where the Northwestern Pike crosses Big Run a mile east of Romney and continuing east along the pike to Shady Grove School.

Spirifer disjunctus, Leptodesma medon, and **Dalmanella tioga** are index fossils of the formation. **Atrypa hystrix** marks the second fossil horizon near the center of the series, below which are calcareous horizons a foot or more in thickness in which sections of crinoid stems may be seen standing vertically in the limestone. **Camarotoechia eximia** is especially abundant in the upper part of the Chemung.

Fossils of the Chemung Series.

(See statement preceding the List of Fossils of the Clinton Series).

Coelenterata
- Zaphrentis marylandicus Clarke and Swartz 4
- Zaphrentis chemungensis Clarke and Swartz 4
- Heliophyllum scrutarium Clarke and Swartz 4
- Aulopora schohariae Hall 4

Echinodermata
- Cladochonus humilis Clarke and Swartz 4
- Palaeaster clarki Clarke and Swartz 4

Vermes
- Spirorbis gyrus Clarke and Swartz 4

Brachiopoda
- *Lingula oherni Clarke and Swartz 4
- Craniella hamiltoniae Hall 4
- Rhipidomella vanuxem Hall 4
- Douvillina cayuta Hall 4
- Douvillina cayuta var. graciliora Clarke and Swartz 4
- Douvillina arcuata Hall 4
- Schizophoria striatula Schlotheim (?) 4
- Schizophoria striatula var. marylandica Clarke and Swartz 4
- Stropheodonta demissa Conrad 4
- Stropheodonta maynardi Clarke and Swartz 4
- Strophonella reversa Hall 4
- Leptostrophia perplana var. alternata Clarke and Swartz 4
- Leptostrophia perplana var. nervosa Hall 4
- Schuchertella chemungensis Conrad 4
- Schuchertella ponderosa Clarke and Swartz 4
- Chonetes scitulus Hall 3, 4
- Chonetes oaklandensis Clarke and Swartz 4
- Productella lachrymosa Conrad 2, 3, 4
- Productella lachrymosa var. marylandica Clarke and Swartz 4
- Productella hystricula Hall 4
- Productus (Marginifera?) hallanus Walcott 4
- Dalmanella carinata Hall 4
- *Dalmanella tioga Hall 4
- *Camarotoechia eximia Hall 1, 4
- Camarotoechia congregata var. parkheadensis Clarke and Swartz 2, 4
- *Camarotoechia contracta Hall 2, 3, 4
- Camarotoechia orbicularis Hall 4
- Cryptonella cf. eudora Hall 4
- *Tropidoleptus carinatus Conrad 1, 2, 3, 4
- Atrypa reticularis Linnaeus 1, 4
- *Atrypa hystrix Hall 4
- Atrypa spinosa Hall 4
- Cyrtina hamiltonensis Hall 4
- Spirifer mckenzicus Prouty 4
- Spirifer (Delthyris) mesacostalis Hall 3, 4
- *Spirifer (Eospirifer) mesastrialis Hall 4
- Spirifer marcyi var. superstes Clarke and Swartz 4
- Spirifer mucronatus var. posterus Hall and Clarke 1, 2
- *Spirifer disjunctus Sowerby 1, 2, 3, 4

*Ambocoelia umbonata Conrad (?) 1, 2, 3, 4
Athyris angelica Hall 4

Pelecypoda

Grammysia elliptica Hall 4
Grammysia subarcuata Hall 4
Grammysia undata Hall (?) 4
Palaeanatina angusta Hall (?) 4
Sphenotus contractus Hall 4
Nucula corbuliformis Hall 4
Palaeoneilo plana Hall 4
Palaeoneilo filosa Conrad 4
Palaeoneilo angusta Hall 4
Palaeoneilo constricta Conrad 4
Palaeoneilo crassa Clarke and Swartz 4
Leda diversa Hall 4
Leptodesma rogersi Hall 4
Leptodesma longispinum Hall 4
Leptodesma agassizi Hall 4
*Leptodesma medon Hall 4
Leptodesma lichas Hall 4
Leptodesma elongatum Clarke and Swartz 4
Pterinea nodocosta Clarke and Swartz 4
Pterinea chemungensis Conrad 2, 4
Liopteria bigsbyi Hall 4
Liopteria marylandica Clarke and Swartz 4
Actinopteria cf. epsilon Hall 4
Schizodus oherni Clarke and Swartz 4
Schizodus frostburgensis Clarke and Swartz 4
Schizodus trigonalis Clarke and Swartz 4
Lyriopecten tricostatus Vanuxem 4
Modiomorpha subangulata Hall 4
Cypricardella tenuistriata Hall 4
Cypricardella gregaria Hall 4
Cypricardella marylandica Clarke and Swartz 4
Cypricardella nitidula Clarke and Swartz 4
Cypricardella cumberlandiae Clarke and Swartz 4
Cypricardella crassa Clarke and Swartz 4
Cypricardella elegans Clarke and Swartz 4
Cypricardella elegans var. angusta Clarke and Swartz 4
Paracyclas marylandica Clarke and Swartz 4
Schizodus chemungensis Conrad 4
Schizodus chemungensis var. quadrangularis Hall 4

Gastropoda

Ectomaria marylandica Clarke and Swartz 4
Ectomaria ecclesiae Clarke and Swartz 4
Bellerophon clarki Clarke and Swartz 4
Bucanopsis maera Conrad 4
Euomphalus tioga Hall 4
Cyclonema concinnum Hall 2, 4
Cypricardella cumberlandiae Clarke and Swartz 4
Cyclonemina crenulistriata var. obsolescens Clarke and Swartz 4
*Cyclonemina multistriata Prosser and Kindle 2
Turbo coronula Clarke and Swartz 4
Trochonema (Gyronema) liratum Hall 4
Macrochilina pulchella Clarke and Swartz 4
Loxonema glabrum Prosser and Kindle 2
Loxonema hamiltoniae Hall 4
Loxonema terebrum Hall 4
Loxonema styliolum Hall 4

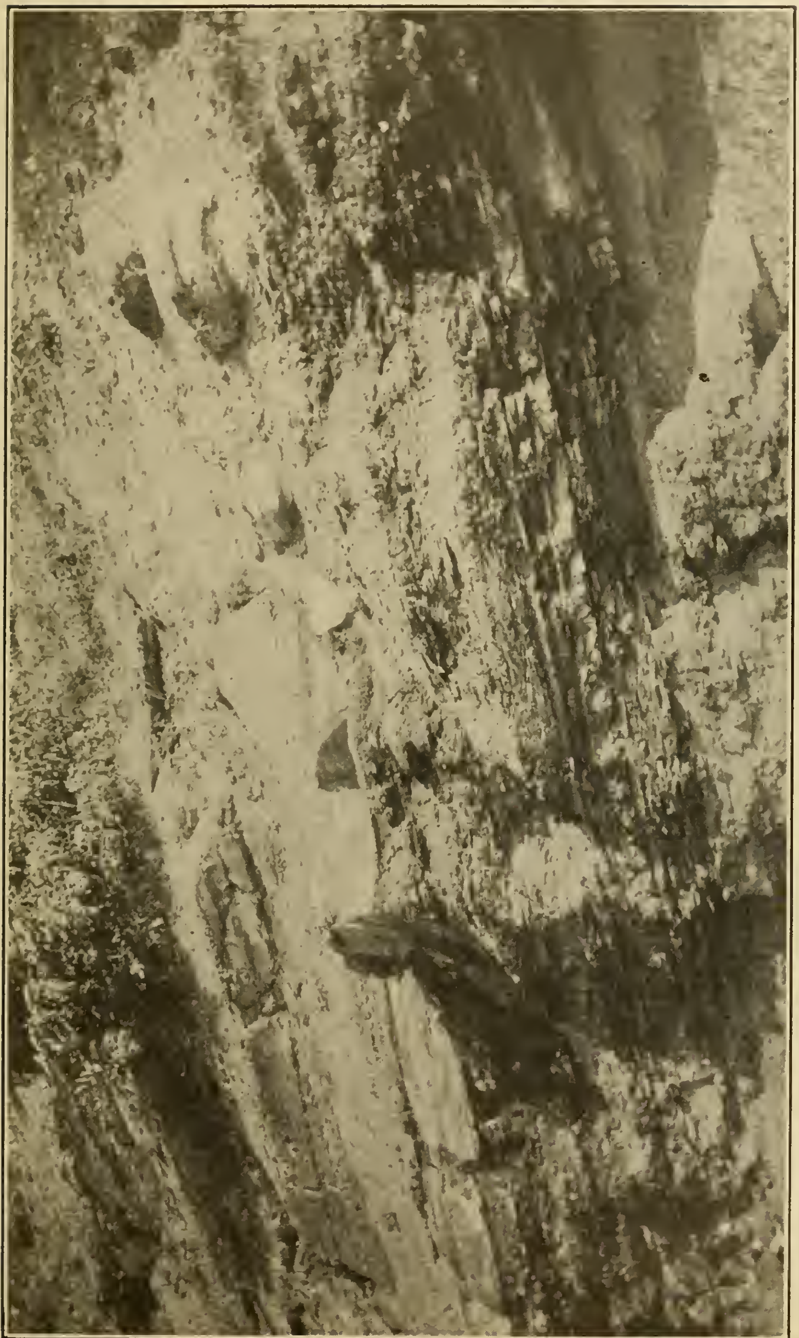

PLATE XX.—Chemung strata a mile west of Okonoko, W. Va.

Trachydomia praecursor Clarke 4
Holopea rowei Clarke and Swartz 4
Holopea marylandica Clarke and Swartz 4
Holopea humilis Clarke and Swartz 4
Orthonychia prosseri Clarke and Swartz 4
Platyceras compressum Clarke and Swartz 4
Diaphorostoma lineatum Conrad 4
Coleolus tenuicinctus Hall 2, 4
Tentaculites descissus Clarke and Swartz 4

Cephalopoda
Orthoceras consortale Hall 4
Orthoceras demum Hall 4
Manticoceras patersoni Hall 4
Sandbergeroceras chemungensis Vanuxem 4

CATSKILL SERIES (MAP SYMBOL, Dck).

The series consists of shales and sandstones that are distinctly reddish in color. In the northern half of the county the sandstone members are thick and greatly disturbed. They extend from the top of the uppermost conglomerate sandstone of the Chemung (the Hendricks Sandstone) to the buff deposits of the Rockwell above. They outcrop along the Northwestern Pike from the Hendricks Sandstone near Shady Grove School to half a mile west of Shanks, where along the pike they are 781 feet thick. In the hills to the south there is an additional thickness of 460 feet without reaching a distinct Rockwell Sandstone, though the location reached is evidently close to the Rockwell, which appears in the mountains farther south. This gives a total thickness of the Catskill as about 1241 feet.

A fossiliferous horizon was noted about thirty feet above the Northwestern Pike six and a half miles east of Romney. Here a reddish-brown sandstone has fragments of brachiopods too small and badly weathered to be identified. The same character of sandstone and apparently the same horizon is to be found on the Western Maryland Railroad a little northwest from Okonoko. Outside of this particular horizon even the fragments of fossils are very rare. This seems to be the horizon from which an occasional **Grammysia** is reported from Maryland.

DESCRIPTION OF PLATE XXI.—Five and a half miles east of Romney and near Little Capon School, the Northwestern Pike crosses an area of Chemung strata where folding, mashing, and shearing are very evident. Note the distinct anticline in the right center and the syncline in the left center.

PLATE XXI.—Chemung strata 5½ miles east of Romney and near Little Capon School on the Northwestern Pike. (See page 94 for description of plate).

There is a chance to obtain the description of an extensive section from Romney east along Big Run, and thence to the top of mountains south of Ebenezer Church. The section is as follows:

	Thickness Feet.
Devonian System.	
Upper Devonian.	
Catskill. Shales and sandstones that are distinctly red in color:	
Reddish-brown sandstone with here and there strata of a lighter color near the top; with calamites	400
Shale and reddish sandstone; calamites in yellow shale about ten feet below top; bed of Pelecypoda fragments thirty feet above base	110
Sandstone, brownish, heavy-bedded	30
Shale, reddish	45
Sandstone, reddish-brown, heavy-bedded.	15
Shale, reddish, ripple-marked	25
Sandstone, in heavy bed, reddish-brown	9
Shale, clayey, reddish	20
Sandstone, dark reddish-brown; contains a two-inch stratum of a conglomerate of white quartz pebbles an inch in diameter in a light-brown matrix	53
Shale, clayey, red and green	265
Shale above and below, red, with a stratum of reddish-brown sandstone in center	74
Sandstone, thick bed, reddish	9
Shale, red, with thin layers of reddish sandstone rarely six inches thick	126
Chemung. Gray sandstone and arenaceous shale.	
Sandstone, gray above, over sixteen feet of shale; lower sandstone massive, only thin partings, grayish, but weathering reddish-brown; with large flattish pebbles of quartz near base; the Hendricks Sandstone	91
Shale, clayey, reddish-brown	15
Sandstone, shaly	5
Sandstone, micaceous, light-gray but weathering brown; near bottom is a fossiliferous gray sandstone, a foot thick	298
Sandstone, thick-bedded above and somewhat cross-bedded; thinner-bedded below, gray	8
Conglomerate, quartz pebbles up to one inch in diameter, pebbles somewhat flattish	3½
Shale, with included layers of a dark-gray sandstone weathering brown; near the base is a six-inch conglomerate of white quartz pebbles over a ripple-marked stratum	326½
Sandstone, upper part cross-bedded, bluish; in center a four-foot quartz conglomerate with flattish pebbles up to an inch and a half in length, largest pebbles in distinct layer; fine-grained, bluish below	25
Sandstone and shale in alternate layers	38

Sandstone, in layers up to four feet thick. Eight feet from bottom the surface of one stratum is marked by crinoid stems on end, above which the three-inch sandstone has faint ripple marks, rounded or worn smooth before covered up	12
Shale, clayey, greenish, with thin sandstone layers	353
Sandstone, fine-grained, dark-gray	1½
Shale, clayey, greenish, including some layers of thin, gray sandstone	15
Sandstone, dark-gray, two inches to twenty inches thick, separated by shale up to six inches thick; upper four feet conglomeratic, the topmost six inches full of flattish white quartz pebbles up to ¾ inch in an arenaceous matrix	16
Portage. Clayey, with thin layers of fine sandstone.	
Shale, clayey, green; with several layers of a gray sandstone two to twelve inches thick	29
Sandstone, with thin partings, ripple-marked at top, bluish	3½
Shale, clayey, over sandstone, gray, ripple-marked	5
Shale, clayey, with thin layers of a grayish sandstone	1231

THE MISSISSIPPIAN SYSTEM

POCONO SERIES (MAP SYMBOL, Cpo).

Of the five divisions of the Pocono Series reported in adjacent parts of the State, only the lowest three are to be found in Hampshire County:

Hedges Shale,
Purslane Sandstone and Conglomerate,
Rockwell Shale and Sandstone (at the base).

ROCKWELL SHALE AND SANDSTONE.

The lowest of these, the Rockwell, is to be found in five different regions. In the hills southeast of Okonoko, the base is encountered at an elevation of 340 feet above the Baltimore and Ohio track (at 900 feet above sea-level). Here the Rockwell is of a light buff colored argillaceous sandstone, nearly a shale, in which are to be found plant remains that are judged to be **Sphenopteris.** Above this as a base the buff shale and sandstone rise to a height of one hundred feet, the hillside being covered with a buff and light-colored weathered sandstone and shale. This area is about a twentieth of a square mile. Across the run west is another small

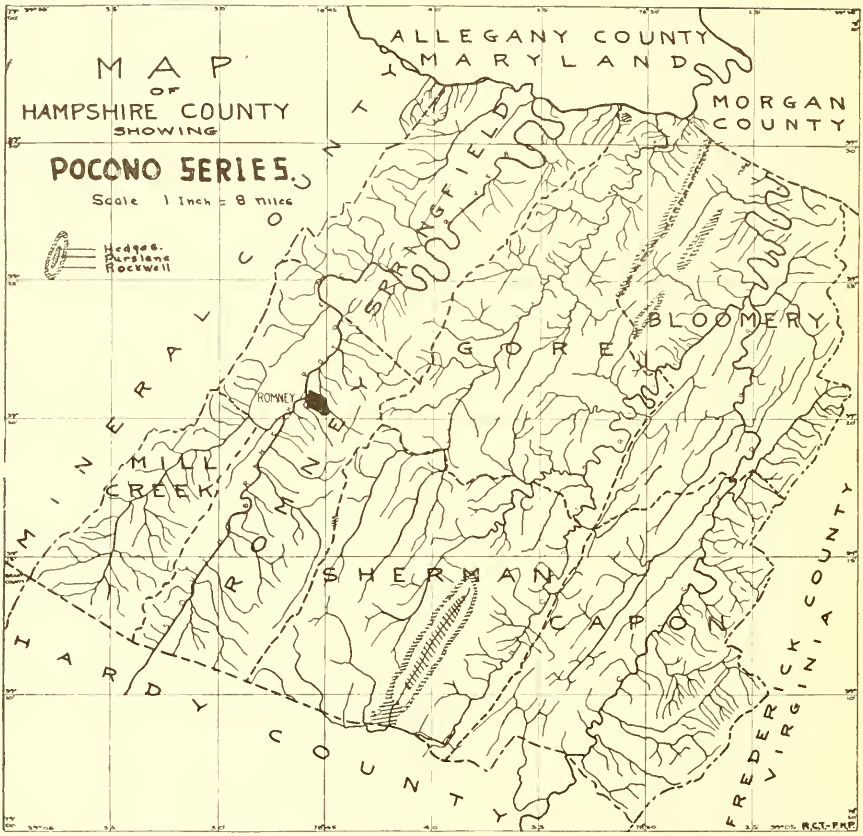

FIGURE 9.—Map of Hampshire County showing Pocono Series. (Figure prepared by Paul H. Price.)

patch about half as large as that east of the ravine. No trace of coal was seen, such as that reported farther north and east.

A second area has its north end a mile and a half southeast of Pawpaw, where the base is at an elevation of 1550 feet above sea-level. The area extends five miles southwest to Spring Gap. On the southwest side of the gap, the Rockwell is continued for a distance of two and a quarter miles to the southwest end of the mountain where the base lies at an elevation of about 1700 feet above sea-level. The base is a distinct medium-grained sandstone of brownish-red color. Near Spring Gap there is a difference of 410 feet between the base of the Rockwell Sandstone and the base of the Purslane Sandstone.

A third locality is along Sideling Hill Mountain. North of Critton Run, it extends but half a mile southwest from the Morgan-Hampshire line; but southwest of the gap, it is found on the two sides of the mountain for a distance of three and a half miles to near Crooked Run, southwest of which it continues for another two and a half miles, where in the southern end of the mountain its base lies at an elevation of 1600 feet above sea-level. In character the sandstone here corresponds to the Rockwell found in Spring Gap Mountain—a brownish, medium-grained sandstone near the base, with buff shales and sandstone above.

A fourth locality is along the flanks of Short Mountain, where the synclinal ridges of which it forms a part are capped by Purslane. In general character the Rockwell here corresponds to that already described. It lies at the steeper angle (dip, 45° southeast) on the west flank of the mountain than on the east flank (dip, 22° 45′ northwest). On the west flank a dip of 45° southeast and an upward slope of 200 feet in a tenth of a mile corresponds to a thickness of 198 feet.

A fifth locality is on South Branch Mountain 1.2 miles southwest of Bethel Church, where a ledge nine feet thick is exposed for a few yards.

In Morgan County, the following fossils were identified by David White, as published by G. P. Grimsley on page 141 of the Jefferson, Berkeley, and Morgan County Report of the West Virginia Geological Survey, in 1916:

Eskdalia 3
Lepidodendron sp. (?) 3
Sphenopteris vespertina 3
Magaspores 3

PURSLANE SANDSTONE AND CONGLOMERATE.

The Purslane Sandstone immediately above the Rockwell is a coarse sandstone and conglomerate composed of white pebbles of quartz, some of which are as large as half an inch in diameter. Such a resistant rock forms the crest of Spring Gap, Sideling Hill, and Short Mountains, except that it does not occur north of Critton Run, where that run crosses Sideling Hill Mountain. Fragments of white quartzite found near the base of these mountains are resistant fragments of this formation, that have endured while the strata formerly below were removed by erosion.

In Spring Gap and Sideling Hill Mountains, the syncline is somewhat unsymmetrical, the western limb being the steeper of the two, and the quartzite there rising to a higher level than in the eastern flank. In Short Mountain the Purslane forms an eastern and a western crest to the double mountain, the valley between being eroded along the axis of the syncline where the strata are of shale. At the western crest a thickness of 220 feet was found for the Purslane. This resistant sandstone and quartzite standing high along the crests of this double synclinal mountain where it rises in jagged masses, presents one of the impressive sights emphasizing the vast erosion that this region has undergone. This sandstone and quartzite is reported present in other counties north, west, and south of Hampshire County, but elsewhere in Hampshire County this remarkably resistant rock has been entirely removed by erosion. It was not observed to be fossiliferous in the county.

In Morgan County, the Purslane is described as consisting of two resistant ledges "with shaly and flaggy ledges between". But one kind of fossil is mentioned (casts of **Lepidodendron**) by G. P. Grimsley in the Jefferson-Berkeley-Morgan Report of the Survey, page 147, published in 1916.

HEDGES SHALE.

But one small area of Hedges Shale is to be found in the county. That area is near the northern end of Short Mountain, where the steep downward bend of Purslane has afforded a protected area in which the lowest portion of the black Hedges Shale over a light-buff sandstone is not yet entirely removed by erosion. The wash from the hillsides has covered the shale with soil along the valley sides, and swampy deposits lie along the center of the valley. So thin are the beds and so narrow is the area where the shale still exists that its presence might possibly remain undetected in the present condition of the valley sides but for former excavations for coal. These slight diggings are now flooded, but black shale with now and then traces of plant remains are still evident in fragments of shale from the small dumps near by. The position of the deposit is such that it is apparently not over 80 feet thick, and the area is so small that it does not warrant drilling even if a little coal has been obtained there in the past. This is the only region in the county where black shale that is really carboniferous exists. In other places where there has been digging for coal the shale is a black Marcellus Shale that contains a little carbon, but not enough to support combustion.

The fragments of plant remains that were recognizable were thought to be leaves of Sphenopteris. Farther north in Morgan County, more extensive deposits of Hedges Shale have yielded the following fossils, identified by David White, as published by G. P. Grimsley in the Jefferson-Berkeley-Morgan Report of the West Virginia Geological Survey, page 153, in 1916. The collection includes material from higher horizons in the Hedges Shale than have been preserved in Hampshire County:

Sphenopteris vespertina 3
Triphyllopteris lescuriana (Meek) Fontaine 3
Triphyllopteris virginiana 3
Protolepidodendron scobiniforme Meek 3
Lepidodendron eskdalia 3
Lepidocystis siliqua 3
Triletes sp.
Carpolithes sp.
Eskdalia sp.

CHAPTER IV

GEOLOGIC STRUCTURE

GEOLOGIC CROSS-SECTIONS

Cross-Section A—A′, along the North Branch.—This cross-section extends in a straight line along the North Branch of Potomac River from the Mineral-Hampshire County line to near Pawpaw. The cross-section is essentially parallel to the northern boundary of the county. For three miles the line of the cross-section lies along the river terrace near Greenspring, then in a mile crosses Valley and South Branch Mountains. A mile east of the junction of the North and South Branches of the Potomac, it extends for the next mile and a half along the river terrace in Allegheny County, Maryland, where the river bends to the south; then, crossed by the river again, it extends through the highlands on the West Virginia side of the Potomac from about half a mile west of Okonoko to a mile east of that place. It then lies along the river flat for two miles and a half to the Morgan County line. As the surface rises both to the north and to the south of this line, the structure is obtained where the railroads cut through the ranges and is transferred along the strike of the strata to a proper position in the line of the section. This is particularly necessary opposite the extensive flat in which Greenspring is located, also between South Branch Depot (French) and near Little Cacapon, in all of which regions there are better outcrops along the Western Maryland Railroad on the north side of the river than there are along the Baltimore and Ohio Railroad on the south side of the river. Four of the contacts of formations are concealed on the south side of the river in these regions.

The cross-section begins with an excellent outcrop of Hamilton at the mouth of a ravine two miles west of Greenspring. West of this point and close at hand, the dark Genesee Shales about three hundred feet thick dip northwestward to the river. A little to the west may be seen the Portage capping the hills of Mineral County and dipping to the northwest.

The section is continued east past the flat of Greenspring by the use of sections that are exposed in railroad cuts from a point two miles west of Oldtown to a point a mile east of that town. These sections are treated as if transferred southwest along the strike of the strata (S. 30° W.) to corresponding points in the line marked A—A′. This entire area where the Marcellus is located does not give a continuous series of outcrops, but there are enough outcrops to make the relation clear. The west end of the group of railroad cuts west from Oldtown reveals strata that are concretionary to near the center of the cut, and that contain an abundance of Spirifer mucronatus to within three feet of the bottom of a stratum marking the base of the Hamilton and the top of the Marcellus. The upper third of the 250 feet of Marcellus that follows is marked by several bands of light-colored calcareous sandstone, and by an occasional Anoplotheca acutiplicata. The Marcellus has in its midst a thick bed of dark sandstone. Above the sandstone the shale is concretionary and contains an abundance of greenish shale, weathering to a light shade of brown. The Marcellus through this portion of the area, especially near Oldtown, is intensely mashed and contains at least two small faults.

From east of Oldtown the cross-section is continued along the south side of the river where North Branch of the Potomac cuts across the northern ends of Valley and South Branch Mountains. Here the structure is rendered conspicuous by the resistant character of the Oriskany Sandstone which rises in a symmetrical anticline. From the relation of the strata it is evident that South Branch joins North Branch along the axis of a syncline, and that the Selinsgrove is concealed beneath the river gravels. In this region the hills to one side of the actual location of the line of the cross-section rise above the vertical profile as given along the river.

From the mouth of South Branch to French, there is a continuous exposure, except for the presence of small ravines. After a few rods there is an anticline with vertical strata, then an almost continuous dip toward South Branch Depot (French) that brings in higher Marcellus strata and the Hamilton, the latter marked by numerous bands of Chonetes and Spirifer. Near the bottom is a bed of Spirifer granulosus. Farther up in the beds Spirifer mucronatus is found in abundance. This same formation is found in the anticline just east of French. Farther east to Okonoko there is a continuous steep dip to the southeast. At Okonoko there is a very slight anticline followed by a syncline on the east, beyond which the strata rise again as steeply as they dipped from the west. Thus Okonoko is in the center of a large syncline the west limb of which extends for two and three-fourths miles to the west and the east limb for an equal distance to the east of that town. The dipping Chemung beds are best seen on the north side of the river in the cuts of the Western Maryland Railroad. Here the sandy shale with frequent beds of a light sandstone four to six inches thick, with a few up to two feet in thickness, are almost continuously exposed. As many as eight or ten ripple-marked surfaces appear along the cut. The dense dark sandstone of the Catskill caps the hills west of Okonoko and again three-fourths of a mile east of Okonoko. In the axis of this syncline the thick reddish sandstone and red shale of the Catskill reach below the river-level, and in the crest of the divide next south of Okonoko and the divide next east are small areas of yellowish sandy shale with Sphenopteris-like plant remains of the Rockwell, the lowest division of the Pocono.

Toward Little Cacapon Station a talus conceals what is in the hillside, but here again the railroad cuts along the Western Maryland Railroad give exposures that reveal what is back of the talus.

Opposite Little Cacapon there are three small anticlines and a small thrust fault. East of Little Cacapon the general dip is southeast and the strata are the Chemung, with the Hendricks Sandstone rising to the crest of Devils Nose.

Cross-Section B—B′, Morgan-Hampshire County Line.—This cross-section follows the Morgan-Hampshire County line from the Potomac River on the northwest and extends 7.53 miles S. 63° E. to the Virginia-West Virginia boundary on Cacapon Mountain. The first 1.7 miles from the west lies in the area of the Pawpaw Quadrangle, the remainder in the area of the Cacapon Bridge Quadrangle.

At Devils Nose, at the very beginning of the cross-section, the line crosses from the area of gray sandstone of the Chemung capped by the Hendricks Sandstone to the red sandstone and red shale of the Catskill. In about a mile the line brings one to the yellowish shale of the Rockwell, capped by the white resistant sandstone of the Purslane, both of the Pocono. On the east side of the mountain the reddish sandstone and shale of the Catskill again appear, above which the Rockwell without the Purslane forms this portion of the crest of Sideling Mountain. After a little over a mile on the reddish sandstone and shale of the Catskill, the character of the rock changes back again to the yellowish sandy shale and gray sandstone of the Chemung. This change is due partly to the rise in strata and partly to descent of surface to the valley of Cacapon River. At the eastern side of the valley the line extends for about a quarter of a mile across the Portage and Genesee strata and then across the Hamilton and Marcellus to the whitish somewhat friable but resistant Oriskany Sandstone. From Sideling Hill Mountain across the valley of Cacapon River, there are reversals in dip and variations in strike, but a prevailing dip to the southeast to near the great mass of Oriskany Sandstone, all revealing not only a mashing effect but even an overturn in the shaly material crowded against the resistant strata to the southeast.

In the immediate vicinity of the line of the cross-section, the various strata that follow beneath the Oriskany are concealed, but a little to the south they are exposed along the flanks of Little and Cacapon Mountains. Up Falling Spring Run one soon reaches the White Medina Sandstone standing on edge, then arching toward the east where it forms the crest of Cacapon Mountain, with a short stretch of Red Medina appearing along the run.

Cross-Section C—C′, Bloomery Gap.—The cross-section begins near Sideling Hill Mountain and extends south 60° east, passing a mile northeast of Forks of Cacapon, about three-fourths of a mile southwest of Furnace School, and about half-way between Bloomery Post-Office and Bloomery School. It ends at the angle in the State line a mile and a quarter east of Good and a mile northeast of Broadway School. The road along which exposures of rock are most accessible lies first a mile south of the line, then crosses to a mile north of the line, then crosses back to a mile south of the line again. The cross-section as a whole has the advantage of connecting regions of less disturbed strata to the northwest with regions of less disturbed strata near the State line. The data obtained are transferred along the strike to where the strike crosses the line selected for the cross-section.

A surprising fact brought to light is that the White Medina Sandstone that forms the crest of Cacapon Mountain north does not here reach the surface. It is the Keefer Sandstone that is at the surface where the gap lies across the axes of the folds, and along another anticline to the west the Keefer is at the surface in a steeply inclined limb.

From a region of red Catskill sandstone and shale, the line crosses an area of light-colored sandy shale and sandstone, the Chemung, and then a more argillaceous set of strata, greenish and yellowish (Portage) to the dark and somewhat calcareous shales (Genesee) beneath the cement bridge over North River at Forks of Cacapon. The Hamilton Shale must be close at hand concealed in the valley side, for Marcellus Shale appears along the nose of the divide between North River and Cacapon River, and the white somewhat friable Oriskany Sandstone lies just beyond to the east where it forms the crest of Castle Mountain, and of the continuation of it in Little Mountain to the northeast.

On the east side of Little Mountain, ledges of Helderberg Limestone appear, beneath which and along the gentle slope north of Furnace School the various strata appear down to the Clinton. Along the roadside to the south the Keefer Sandstone at the base of the Niagara Series may be seen rising nearly vertically, a few yards east of which is an old mine-prospect tunnel into the Clinton. Other drifts for Clinton Iron Ore are to be seen a little to the southwest in this hill. Above the Clinton rises a long ridge of Keefer Sandstone in an anticline a vertical limb of which forms the vertical wall of White Rock Mountain east of Cacapon River.

From Furnace School to Bloomery Post-Office, a distance of two miles as measured in the direction of the cross-section, there are two anticlines and an included syncline the limbs of which stand at high angles. The white Keefer Sandstone and the red ledges of Bloomsburg Sandstone alternate in supplying the side of the gap with loose rock closely packed together. It is in this region half a mile northwest of Bloomery Post-Office that the axis of Cacapon Mountain crosses the line of the cross-section, where the roadside for the larger portion of a mile is strewn with resistant fragments of a white sandstone (Keefer) that forms a low arch rising to the north, close above which white sandstone comes the red Bloomsburg Sandstone. Farther away to the northeast, beyond the outcropping Clinton on the flank of the mountain, rises the White Medina forming the crest of the mountain, but, toward the gap, plunging down beneath those later beds.

At Bloomery Post-Office it is the Bloomsburg Sandstone that forms a conspicuous ledge dipping to the southeast. From here the road goes south along a syncline in which Bossardville appears in the hill to the west, and past Bloomery School the Bloomsburg again appears by the road. In the valley to the east Rondout, Bossardville, and Helderberg are passed in quick succession where the strata along the road are not well exposed. They are better exposed along the road to the east. Along the road over Bear Garden Mountain toward Good it is the Oriskany that lines the hillside with low ledges and with fragments of resistant rock even to Laurel Church. From here on to the State line the dip of the strata to the southeast is such that the road crosses successively the Marcellus with its included Selinsgrove, the Hamilton, the Genesee, and a considerable portion of the Portage.

Cross-Section D—D', through Springfield.—This cross-section extends from the Hampshire-Mineral County line in a direction south 64° east through Springfield to the Virginia-West Virginia State line about three miles a little north of east from Capon Bridge. It is thus very nearly in a direction at right angles to the strike and lies near roads from the county line on the west to the South Branch of the Potomac, and from Salem Church to the Virginia line.

From a syncline east of the Mineral-Hampshire line to Springfield the dip is to the northwest, and the outcrops pass from the Chemung to the Portage, Genesee, Hamilton, and Marcellus. Half a mile southeast of Springfield is the beginning of two anticlines at the southwestern end of Valley and River Mountains, the Oriskany there rising in the folds, with Marcellus Shale occupying the syncline between. Beyond River Mountain the South Branch of the Potomac River swings in large arcs of meanders depressed in Marcellus Shale. At South Branch Mountain the cross-section quickly reaches Chemung and then Catskill strata, on which two groups of strata, at the surface in anticlines and synclines, the cross-section extends for nine miles. In another mile the cross-section reaches the rising strata of Oriskany Sandstone at Ice Mountain. From this point on for four miles there are anticlines and synclines closely arranged in which strata from the Keefer to the Oriskany appear. East of the Cold Stream School area the Cacapon River lies in a valley of Marcellus Shale a mile wide, east of which the Oriskany Sandstone rises to form Bear Garden Mountain. In the remaining one and three-fourths miles to the Virginia State line the higher strata appearing at the surface reach from the Marcellus Shale to the Chemung.

Cross-Section E—E', along the Northwestern Pike.—This cross-section extends from the Hampshire-Mineral County line northwest of Romney in a direction south 60" east, passing a mile north of Romney, near Chestnut Grove School, Ebenezer Church, a little to the south of Frenchburg, through Augusta, near Green Mountain Church, across Cacapon Mountain and Cacapon River to the Virginia-West Virginia State line half a mile north of Lehew. This cross-section is considered the most important one of all, for it is centrally located across the strike and not far from good roads along the greater part of its length.

This section begins in the Chemung in the west side of the county and crosses the mountain of Helderberg and Oriskany known as Mill Creek Mountain a mile northwest of Romney. Near Romney, South Branch River lies on the Marcellus Shale, east of which is the Portage, Chemung, and Catskill, much of it folded and mashed for eleven miles, to the Oriskany Sandstone at Hanging Rock Gap. East of Hanging Rock Gap, the cross-section lies in a region of plunging anticlines and synclines for two and a half miles to the broad area of Oriskany Sandstone, the eastern portion of which rises into Cacapon Mountain west of Cacapon River. East of the river the strata form a broad syncline with Catskill strata near the center and the Chemung rising again toward the State line near Lehew.

Cross-Section F—F′, near Intermont.—This section begins at the Hampshire-Mineral County line near Russellville and extends south 60″ east through the angle in the Hampshire-Hardy County line near Intermont to the Virginia-West Virginia State line in the Shenandoah National Forest.

The first four miles of this section, on the west, crosses a large syncline involving the Marcellus—Portage—Marcellus. East of this syncline line Mill Creek Mountain, a mile and a half wide, in the central portion of which the Niagara Shale rises to view along the axis of the anticline. Immediately east of Mill Creek Mountain the South Branch of the Potomac lies on Marcellus Shale. To the southeast for about eight miles the region is a broad syncline with strata from the Marcellus to the Catskill appearing in the west limb and back to the Chemung in the east limb. Farther to the east lies the northern half of Short Mountain in another syncline that is five miles broad. This mountain is cut lengthwise by Meadow Run, so that the mountain appears double. The resistant strata forming the crests are the Purslane. In the northern part of the valley is a small area of Hedges Shale, the highest strata in the geologic series to be found in the county, with the exception of the alluvium and terrace deposits.

From North River for two miles southeast the strata form an anticline in which the Oriskany marks the high ground on the flanks, from which strata consecutively to the Rondout appear toward the center. A little to the south the Bloomsburg also comes to the surface. For two miles farther to the angle in the county line near Intermont, there are variations in dip with the Oriskany at the surface. From Intermont for three miles southeast occurs another large syncline in which strata appear consecutively from the Marcellus to the Chemung, and back again to the Marcellus. In the next mile the strata are on edge. First, at Capon Springs, the Oriskany Sandstone rises as a wall. Then follow the strata in descending order to the Red Medina, which comes to the surface near the top of the mountain. Here the White Medina rises, and, arching over the Red Medina, forms the crest of the mountain. A little to the north the axis of a second fold near the first is cut through into the Maysville Series of the Ordovician System. Thus between this point and the center of Short Mountain, eleven and a half miles northwest, the entire extent of the geologic series in Hampshire County comes to view, including even the Tertiary gravels and the alluvium, which are along Cacapon River.

Cross-Section G—G′, Hampshire-Hardy County Line.— This section follows the Hampshire-Hardy County line from the Hampshire-Mineral boundary on the west near Elliber Spring to the angle in the county line three and a half miles southeast of Rio. From this point on, the F—F′ cross-section already described is essentially a county-line section.

The cross-section begins in the Helderberg-Oriskany high ground at the Hampshire-Mineral County line. East of this for four miles the region is essentially that of a broad syncline in which the strata from the Marcellus to the Portage and back to the Marcellus appear. In the next mile the section is across an anticline much like the corresponding part of the F—F′ cross-section. The next mile to the east presents a different feature. Here a fold with the Oriskany at the surface forms a straight steep-sided cynclinal valley occupied by the South Branch of the Potomac River. (The Trough"). For the next seven miles the strata form a broad syncline with strata from the Marcellus to the Catskill forming the west limb and the Catskill and Chemung the east-limb. From this point to near Rio the structure is again that of a large syncline with Chemung and Catskill strata at the surface except in the axis, where Rockwell Standstone appears. Close to Rio the strata are essentially on edge along North River. In the remaining two miles the structure is that of an anticline in which the highest strata are the beds of Oriskany on the limbs of the anticline, from beneath which the strata rise consecutively down to the Bloomsburg. The floor of the valley along the axis of the anticline is chiefly Rondout Shale.

POSITIONS OF ANTICLINES AND SYNCLINES

In tracing the anticlines and synclines across the county an endeavor is made to connect the folds with the corresponding ones in Berkeley and Morgan* Counties and in Maryland* and Pennsylvania,* using the names applied in those regions. On the west are folds already traced in Mineral County. On the South the locations of the axes are given to assist in correlation in that direction along the Hampshire-Hardy County line.

North Mountain Anticline.—The great North Mountain forms the Virginia-West Virginia boundary for a distance of seven miles in the southeastern part of the county. In Berkeley County the fold is described as a faulted overthrust. In Hampshire County the west limb is vertical, and no fault observed. The strata are mostly concealed by debris of the mountainside, but White Medina, Clinton, Keefer, Helderberg, and Oriskany were observed between the crest of the mountain and Capon Springs, which come out of the Oriskany Sandstone. The crest of the White Medina has a small syncline in it along which a longitudinal valley is eroded down into the Martinsburg Shale; but the valley belongs to the anticline and is not a part of the "Great Valley" farther east.

Meadow Branch Syncline.—The area from Cacapon River in the southeastern part of Hampshire County is a part of a large synclinal area which extends across the northwestern part of Virginia into Berkeley County. The continuation of this synclinal area includes a minor fold known as the Ferrel Ridge Anticline in Berkeley County. This faulted anticline dies out in that county.

In Hampshire County the area occupied by this syncline extends from Good southeast to the State line. To the southwest it includes all the area east of Bear Garden and Cacapon Mountains as far south as Lehew. Near Good is located the C—C′ cross section through Bloomery Gap; near the Pleasant Grove Schoolhouse is the D—D′ cross-section; and near Lehew is the E—E′ cross-section. Southeast of Lehew to the county line the area is bounded by the vertical wall of Oriskany Sandstone in the base of which is Capon Springs. The whole of this synclinal area is thus shale at the surface, hence eroded into a broad valley, that of Cacapon River.

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*See W. Va. Geological Survey Report on Jefferson, Berkeley, and Morgan Counties; Maryland Geological Survey, Allegheny County Report; Second Geological Survey of Pennsylvania, Report T2, Bedford and Fulton Counties.

Cacapon Mountain Anticline.—In Morgan County to the northeast the Cacapon Mountain Anticline is recognized, extending at least to Potomac River, which it reaches between the towns of Great Cacapon and Hancock. The multiple character of the anticline is noticeable at the northward end near the Potomac.

This anticlinal mountain capped by White Medina Sandstone extends for four miles along the Virginia-West Virginia State line of Hampshire County, then, as it plunges southwest, the multiple character of it is evident in the C—C′ cross-section through Bloomery Gap, where the Keefer Sandstone is at the surface along the road. To the west of the mountain is a parallel fold that becomes Ice Mountain farther south. To the east are two other folds extending as far as Good, southwest of which town the Oriskany ridge along the anticline is recognized as Bear Garden Mountain. Between Bear Garden and Ice Mountains, there is a continuous alternation of anticlines and synclines, as revealed in the D—D′ cross-section through Springfield and across Bear Garden Mountain. Along the E—E′ cross-section similar anticlines and synclines are to be noted from Cacapon Mountain along the west side of Cacapon River to Hanging Rock Gap close to North River. The same is true clear to the Hardy-Hampshire County line. Where the Oriskany Sandstone is brought to the surface it resists erosion; thus the entire region consists of mountains of Oriskany Sandstone arranged in echelon parallel to the strike. Where shale is brought to the surface erosion has cut deep valleys. The entire region is very rugged. Cross-sections D—D′, E—E′, F—F′, and G—G′ all cross this area. At the county line Baker Mountain is in one anticline, and the Dutch Hollow region east of Staacks Gap is a large eroded anticline with minor folds.

Sideling Hill Syncline.—The Pigeon Cove (east) and Franklin (west) Anticlines in Pennsylvania are not yet traced across Maryland and are not recognized in Morgan County of West Virginia. The entire area from Cacapon Mountain Anticline to Whip Cove Anticline (also called Orelans or Pawpaw Anticline) in Morgan County is assigned to the Sideling Hill Syncline. In Hampshire County this Sideling Hill Syncline is continued southwest eight miles by a ridge of the same name, broken only by Critton Run and Crooked Run. The axis appears in the D—D′ cross-section just east of Slanesville. In the E—E′ cross-section along the Northwestern Pike, the axis of the syncline is crossed three-fourths of a mile east of Tearcoat Church. Farther southwest it is continued by the double synclinal mountain known as Short Mountain to the Hampshire-Hardy County line.

Anticline between Sideling Hill and Spring Gap Mountains.—Along the Morgan-Hampshire County line the axis of the anticline between the Sideling Hill and Spring Gap Mountain Synclines is lost in a slight overturn that exists in the Catskill Shale east of Spring Gap Mountain. Farther south the Catskill sandstone is steeply inclined, and the axis of the anticline is evident. A mile east of Spring Gap it is also evident. In the D—D′ cross-section through Springfield, it appears a mile and a quarter southeast of Salem Church. In the E—E′ cross-section, it appears at Augusta, southwest of which place it merges with the Whip Cove (also called Pawpaw and Orleans) Anticline.

Spring Gap Mountain Syncline.—This syncline is marked by Spring Gap Mountain, the northern end of which is just north of the Morgan-Hampshire County line. The mountain continues seven miles southwest, broken only by Spring Gap. In the D—D′ cross-section it is noticeable a mile southeast of Salem Church, but fades out farther southwest where the two adjacent anticlines merge.

Whip Cove Anticline (Orleans Anticline of Maryland and **Pawpaw Anticline** of Morgan County).—The Whip Cove Anticline of Pennsylvania is traced through Maryland under the name of Orleans Anticline, which is reported to become less conspicuous where it crosses into West Virginia. This is evidently the anticline that appears in the A—A′ cross-section a quarter of a mile west of Little Cacapon. It appears in the D—D′ cross-section a mile and a third northwest of Little Cacapon Mountain. In the E—E′ cross-section it appears half a mile south of Frenchburg. In the F—F′ cross-section it appears as a double fold, the western one at Harts Church, and the eastern three-fourths of a mile to the southeast. It crosses into Hardy County as a single fold where the road southeast from Horn Camp School reaches the county line.

This fold is inconspicuous in its topographic effect except where resistant strata are brought to the surface in the Chemung and Catskill strata and thus stand out in ridges as in the southern part of the county. In the county as a whole it marks an almost inconspicuous dividing line in the midst of a broad area that is synclinal on the whole, extending from the Oriskany ledges of Ice Mountain and North River Mountain on the east to the Oriskany ledges of South Branch and Mill Creek Mountains and Sawmill Ridge on the west.

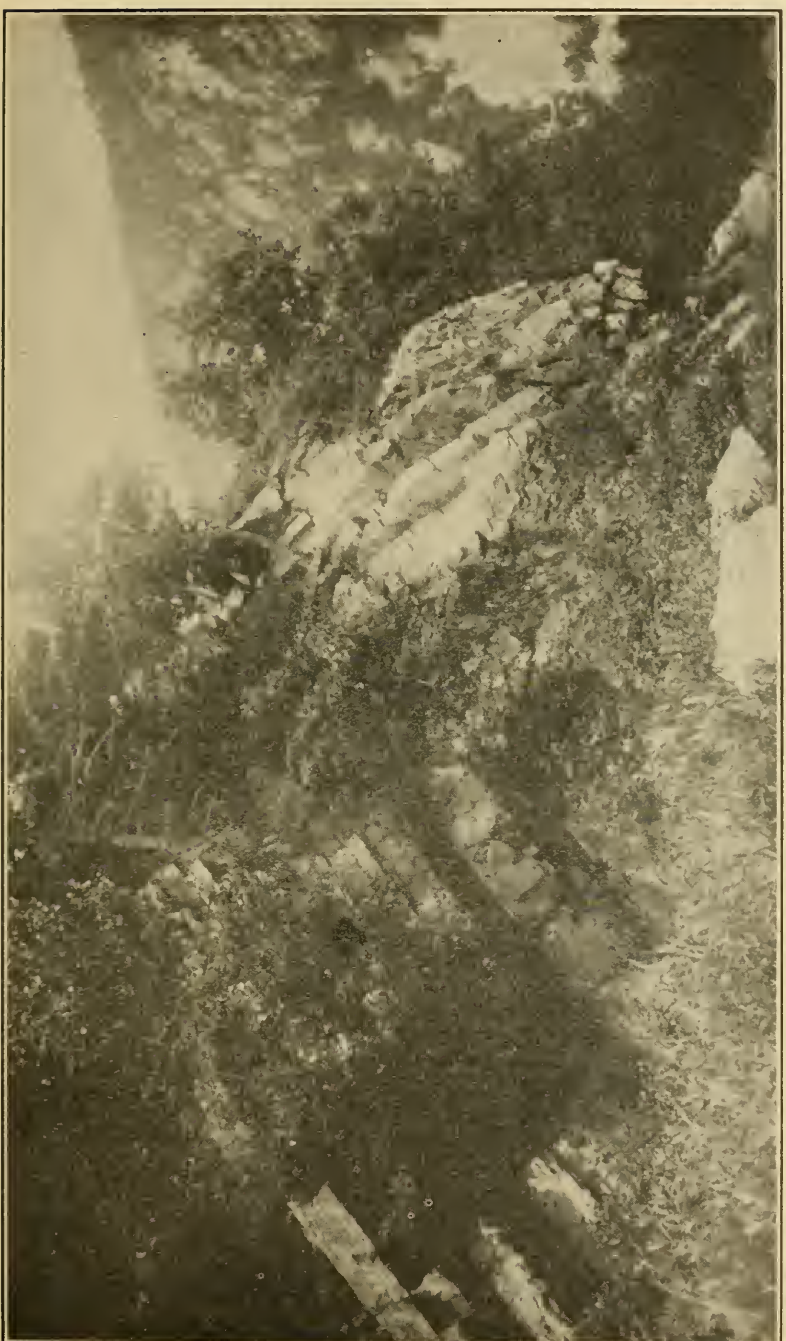

PLATE XXII.—Anticline of Oriskany Sandstone south of "Caudy's Castle" (Castle Rock), near Forks of Cacapon. East of the Castle this anticline is concealed beneath the river bed, but to the south, about half-way to "Bubbling Spring", it appears along the west side of the river bed.

Town Hill Syncline.—In the Pennsylvania report the region between the Whip Cove Anticline on the east and the Broad Top Anticline on the west is occupied by several short folds in the northwestern part of Fulton County, Pennsylvania. In Maryland this area is grouped into the Town Hill Syncline, which includes the area from a quarter of a mile west of the station of Little Cacapon, for a distance of four miles west, to a quarter of a mile east of French. In Hampshire County this is an area of synclinal mountains, and of ridges of resistant rock alternating with lower ground of less resistant rock. South Branch Mountain in the D—D′ cross-section through Springfield owes its height to resistant Chemung and Portage strata. In the E—E′ cross-section along the Northwestern Pike the high ground three miles southeast of Romney is Catskill with Chemung strata on each flank. In the F—F′ cross-section Piney Mountain is distinctly a synclinal mountain, as is also South Branch Mountain in the G—G′ cross-section.

Pratt Valley Folds.—Along the Potomac are three minor folds within a mile east of South Branch Mountain corresponding to the Pratt Valley Folds of the Maryland Survey. A continuation of one of these axes lies along the valley of South Branch to two miles east of Grace. It is detected in the Marcellus Shale in the outskirts of Romney, but not southwest of that point. The fold is therefore considered to die out about two miles south of Romney. From that point on, the dip corresponds to that of the broad synclinal area to the east (Town Hill Syncline); and farther north the area west of this faint continuation of the Pratt Valley Folds is also included in the same synclinal area, to the Broad Top Anticline.

Broad Top Anticline (Stratford Ridge Anticline of Maryland, continued in South Branch and Mill Creek Mountains of Hampshire County.)—Apparently the Broad Top Anticlinal area of Pennsylvania with its three anticlines is continued southwest on the west side of Fifteen Mile Creek as the Stratford Ridge Anticline of Maryland, including minor folds both to the east and to the west.

In Hampshire County these same anticlinal folds are continued southwest. The most pronounced anticline is marked by a ridge of Oriskany Sandstone that is known as South Branch Mountain (including a faint secondary fold to the east). This is a continuation of the axis of Stratford Ridge in Maryland. Close to the North Branch of the Potomac, Valley Mountain lies close beside South Branch Mountain as a separate anticline of Oriskany Sandstone, but these

PLATE XXIII.—A joint-plane in Marcellus strata along which somewhat of faulting has taken place. The slickensided surface has weathered off in places. The direction of the fault is N. 73° E. The location is in the third cut west of Oldtown, Maryland, opposite the flat at Greenspring.

two anticlines come together four miles southwest at White Horse, and again separate. In the D—D′ cross-section through Springfield, both of these anticlines appear, and both are plunging southwest where the road from Springfield goes southeast past Raven Rocks. A little west of the southern end of Valley Mountain another anticlinal ridge of Oriskany Sandstone rises that passes close to the east side of Grace. It is essentially a continuation of the Valley Mountain Anticline, and is continued past Wapocomo (The Rocks) in what is known as Mill Creek Mountain. Southwest of Mill Creek Gap a second fold rises on the east which is completely absorbed into the main fold a mile north of the E—E′ cross-section, and the main fold continues on past the Hardy-Hampshire County line.

At Sector a parallel anticline of Oriskany Sandstone rises above the flood-plain of the river and becomes Sawmill Ridge to the southwest. It is in the narrow steep-sided syncline between this anticline and that of Mill Creek Mountain that "The Trough" lies through which South Branch flows in a straight line. Sawmill Ridge is thus a continuation of the anticline marked by the Oriskany Sandstone of South Branch Mountain near the Potomac. This anticlinal fold is continued in the eroded Hamilton and Marcellus Shales a mile east of Grace; it is noticeable as a crumpling in the Marcellus Shale half a mile east of Romney, and is probably continued beneath the river valley to the point of emergence of Oriskany Sandstone across the river east of Sector.

Oldtown Folds.—The Pennsylvania Report (T2) describes three anticlines and two included synclines as occupying the area northwest of Greenspring:

Broad Top Anticline (on the east),
Felton Syncline,
Snyders Ridge Anticline,
Snyders Ridge Syncline,
Sheavers Creek Anticline (on the west).

All but the most westernly one are described as multiple, and Snyders Ridge Anticline as having five minor axes. In Maryland the entire area is treated as a single complex synclinal area, to which the name Oldtown Folds is given. In Hampshire County the three locations that are essentially anticlinal are noticeable in the A—A′ cross-section along Potomac River. In the D—D′ cross-section through Springfield two locations are noted that are essentially anticlinal, but in the other two cross-sections, E—E′ and F—F′, no such division is recognizable. The area involved is the broad region of shale, crushed and in one place somewhat overturned, west of Valley and Mill Creek Mountains. It therefore seems advisable to consider the crushed area as a unit and to adopt the name used in the Maryland report, in which the area is traced from the Pennsylvania line to Potomac River.

Clearville Syncline (Polish Mountain Syncline of Maryland).—This pronounced syncline of Pennsylvania is traced across Maryland under the name of Polish Mountain Syncline. In Hampshire County the eastern limb only is present in the A—A′ cross-section along North Branch where it is found for a mile east of the Mineral-Hampshire County line. Evidently the Warrior Anticline ends just north of Potomac River, for Reger in tracing the Big Springs Run Syncline finds it to unite with the Clearville Syncline four miles southwest of North Branch.

Along the D—D′ cross-section through Springfield, the axis of the Clearville Syncline lies one-half mile southeast of the Mineral-Hampshire County line. On the E—E′ cross-section, parallel to the Northwestern Turnpike, the axis lies four-tenths of a mile from the county line. On the F—F′ cross-section it lies at a point two miles southeast of the county line and at three-fourths of a mile south of Sandy Hollow School. To the northwest the strata rise toward the Beaver Run Anticline just north of where the Elliber Syncline dies out. On the G—G′ cross-section its axis is two and a half miles southeast of the Mineral-Hampshire County line. It is at this point that the axis of the Clearville Syncline enters Hardy County. West of this point the strata rise to what appears to the writer is a continuation of the Beaver Run Anticline. It is a branch of the Beaver Run Anticline that Reger represents as uniting with the Patterson Creek Mountain Anticline west of Elliber Syncline.

Beaver Run Anticline.—This anticline Mr. David B. Reger traces along the eastern part of Mineral County. It forms the western boundary of Hampshire County from seven and a half miles, southwestward, to three and a halt miles from the Hardy-Hampshire County line, and then enters Hampshire County. It is to this anticline, east of the Elliber Spring Syncline, that the strata rise in the western mile and a half of the Hampshire-Hardy County line.

FAULTS.

A fault is a displacement of strata along some plane of fracture. There is no overthrust fault within the limits of the county. The fault that Grimsley describes as along Cacapon Mountain fades out toward Hampshire County, leaving only a pronounced double fold in Cacapon Mountain the left side of which is there vertical. So also in the southeast corner of the county, the double-crested anticline with vertical limb toward the west is not accompanied by faulting within the limits of the county.

Slight overthrusts were described in the Marcellus Shale. These are not parts of a pronounced overthrust extending through the region but are results of mashing and shearing to which the weak members in an anticline are subjected. Near Frenchburg another line of mashing and incipient thrusting extends northeast-southwest without forming a distinct overthrust.

Joint-planes that have been described and illustrated are planes on which there has been a little displacement, to that extent illustrating normal fault-planes. These are entirely local. No normal fault of pronounced character has been located within the county.

UNCONFORMITIES.

A plane of unconformity is an old land surface developed when the lower strata were exposed to weathering, then later (on subsidence) covered by deposits of the overlying strata.

Evidences of unconformity within the county are of three types, seen in overlap, weathering, and fossils, and related to the changes in sedimentation previously described. The great extent of White Medina quartz conglomerate indicates the presence of a shore-line near by along which the gravels from a crystalline area are shifted back and forth by wave and current action. Such a gravel deposit resting on an oxidized deposit indicates a sea advancing upon the land, while such a gravel deposit over a shale not marked by oxidation indicates either a local variation of conditions along the shore, or, if extensive, indicates a rising of the shore, along which the gravel is made to spread over finer deposits farther from the earlier shore-line, and thus over off-shore deposits laid down contemporaneously with coarser deposits near shore. It is such graduations as these that underlie questions as to just where the plane of unconformity should be considered placed in the relation of the White Medina to the Red, and of these and the Gray to the Martinsburg Shale. Here also is a marked faunal break, from the faunas of the Martinsburg Shale below to the faunas of the Silurian Series above.

The Keefer Sandstone at the top of the Clinton and below the Niagara has the same relation to deposits below and above that the White Medina bears to the Red Medina below and the basal part of the Clinton above. The shoreline was near at hand (toward the east). As the Clinton ores were laid down in collecting areas, which are aquatic rather than terrestrial, the area of unconformity is judged to be near but not in the immediate locality.

The Bloomsburg Sandstone is reddish because of oxidized iron that it contains, due either to oxidized material washed in with the sand or to that carried into it later by underground circulation on uplift. In either case neighboring shore conditions are indicated, which on subsidence would be covered by deposits laid down in deeper water of an advancing sea. While the Bloomsburg and Rondout are here marine in character, the marine conditions are not pronounced. Farther north (New York) the conditions indicate the drying up of an extensive local sheet of water. Thus the plane of unconformity where it is evident would come above the Bloomsburg rather than below it.

Much of the varying thickness of the Oriskany seems due to erosion, in connection with which the fossils were dissolved out by underground circulating water and the sand impregnated with iron. Here the evidence of unconformity is more pronounced than in the two preceding cases, and in addition to this there is a marked change in the fossil content of the rock.

The unconformity between the Pocono and the Catskill is very pronounced. The extensive non-fossiliferous red beds of the uppermost Catskill give evidence of terrestrial conditions, upon which the coarse sands of the Pocono with marine fossils are laid down.

In all of these relations no differences in dip in adjacent formations are noted, all adjacent strata seeming to be affected alike in the folding. Without difference in dip between the adjacent beds the unconformities are to be considered of the variety known as disconformities. The disconformities between the Ordovician and Silurian, between the Silurian and the Devonian, between the Lower Devonian and the Middle Devonian, and that between the Upper Devonian and the Mississippian are all sufficiently distinct to mark evident disconformities, that above the Keefer being possibly a non-evident disconformity. The marked changes in fossil content between various other successive beds are not due to changing conditions of habitat that are purely local (facies), for important differences are to be traced through the entire Appalachian region, differences not here discussed.

CHAPTER V.

ECONOMIC MATERIALS AND CONDITIONS.

SAND AND GRAVEL.

Sand and gravel may be obtained where the Oriskany Sandstone is not well cemented, as in the base of the Hanging Rock Gap, and in numerous places along the base of exposures of the sandstone where it has been deposited by stream action after it had been weathered from the sandstone. The sources are ample for all building purposes. In Berkeley County, the stone when crushed and washed serves as an excellent glass-sand; but in Hampshire County there is generally too much iron in the sandstone, and dearth of coal and gas and absence of ready markets forbid competition with other localities where a more suitable sand is near at hand and all other conditions are favorable. Sand and gravel are also found weathered from the White Medina, from the Keefer, and from the Purslane; but these rocks are not easily disintegrated. They now form high points in the ridges; and the White Medina especially is remote from all but timber and pasture land. Indeed, where these sandstones are abundant the soil is poor. The sand is most easily obtained along the streams. Undoubtedly there are pockets of sand in the gravelly bottoms of South Branch and Cacapon Rivers that can be found on searching where sand can be dredged in abundance, with water near at hand for washing and for transportation in chutes.

SANDSTONE.

Sandstone is abundant—too abundant for the good of agriculture. It forms steep cliffs in many a mountain fold, and steep slopes where erosion is vigorous when the trees are removed, and forms a soil too poor and rocky to make terracing worth while. Dimensional stone of about all sizes needed is to be found, though where folding is intense the joints are too numerous. The White Medina yields a coarse white conglomerate sandstone generally cemented with quartz and of great strength and durability. It does for foundations and piers but is generally too coarse and too glaringly white. The same is true of the Keefer and of the Purslane. The Bloomsburg furnishes a fine-grained brownish-red sandstone, uniform in color, and enduring. It might have been used for trimming had buildings been erected near that required such stone.

Oriskany Sandstone is more varied than the other sandstones. It is generally of a brownish hue and fine-grained. Sometimes it is found nearly white, especially where it is not well cemented. Sometimes it is dark-gray and calcareous. This forms a superb stone for the basal layers of macadam. It is the kind of material selected for that purpose in Mill Creek Gap and crushed there for use along the Northwestern Pike.

LIMESTONE.

The limestone quarried at Bloomery and in Bloomery Gap belongs to the Bossardville of the Salina Series, which, on analysis by B. B. Kaplan, Chemist of the State Geological Survey, yields the following:

	Per cent.
Silica (SiO_2)	9.90
Ferric Iron (Fe_2O_3)	0.68
Alumina (Al_2O_3)	0.64
Calcium Carbonate ($CaCO_3$)	84.10
Magnesium Carbonate ($MgCO_3$)	4.27
Moisture	0.70
Total	100.29

Under present conditions the manufacture of lime and cement as an industry can not be maintained in competition with great plants located near lime, shale, coal or gas and near large markets. There is, however, a need for crushed limestone and shale in road construction where the limestone serves as a binder; and a need for limestone siftings to neutralize an acid soil. Limestone is necessary to make an alkali soil in the cultivation of clover and alfalfa. There is an abundance of limestone for all such purposes near Bloomery, south past Slanes Knob, and in Mill Creek Mountain west from Sector. It is not an attractive stone for building purposes.

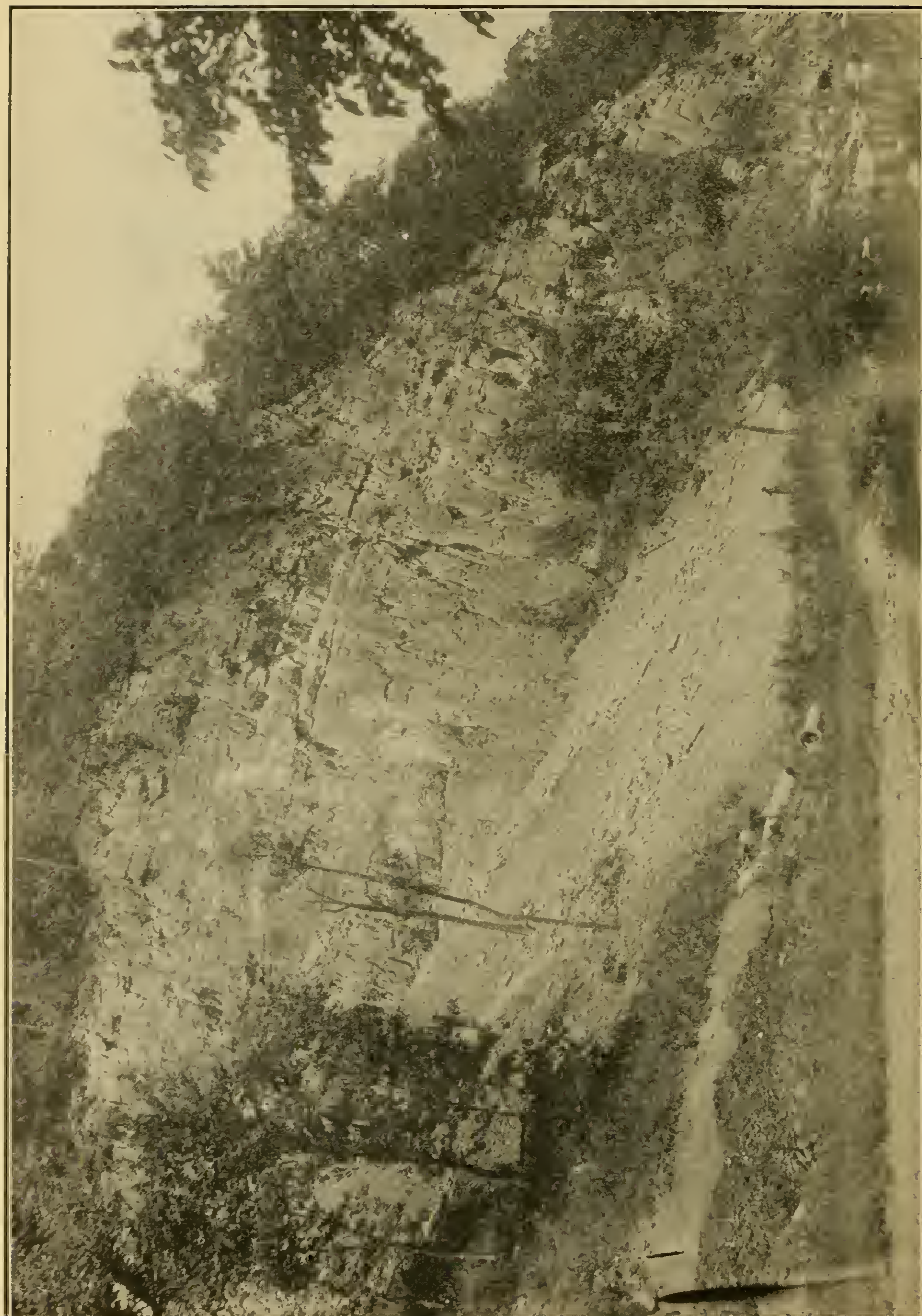

PLATE XXIV.—Oriskany Sandstone and Shriver Chert at Mechanicsburg Gap. (See page 123 for description of plate.)

DESCRIPTION OF PLATE XXIV.—At Mechanicsburg Gap, Mill Creek crosses from the west to the east side of Mill Creek Mountain. Here the Oriskany with the dark Shriver Chert beneath it rises in two arches one of which is here shown in the picture. When work was begun to complete the Northwestern Pike, a stone crusher was installed in the gap and this choice source of road material was utilized in construction of the pike from seven miles east of Romney west to the Hampshire-Mineral County line, and south to Moorefield.

NO COAL.

A little coal has been mined from the Hedges Shale found in Short Mountain, but even if the coal is not already all mined out it is too small in quantity to deserve exploitation. This is the only locality in the county where even a little coal is found. Black Marcellus Shale has been dug into northwest of Romney with the hope of finding coal, but the material found is not a fuel. Note the small amount of carbon and the large amount of ash in the following analysis of some of the most coal-like fragments that were seen near the diggings. The analysis was made by B. B. Kaplan, the Chemist of the Survey:

	Per cent.
Moisture	0.58
Volatile Matter	4.15
Fixed Carbon	7.62
Ash	87.65
Total	100.00

SHALE.

Shale is simply another name for ancient mud, of which there is a great variety with various uses. It is the shale that occurs in the wide valleys where the largest and best farms are located, for the shale weathers readily and aids in forming the best soil.

There is in the county none of the form known as slate—a dense, fine-grained, metamorphosed rock, hardened by heat and pressure.

The dark calcareous shale from the Hamilton and Genesee make fine road material to place on the small rock above the base. It easily crushes under traffic, packs in between the coarser material, and cements itself together. The Marcellus Shale also makes excellent surfacing material, but it lacks the lime, does not cement itself together as do the others, and softens more readily under rain. Yet, if well drained, it makes a smooth, easy-riding surface. The shale areas are notable for their good roads. This is partly because the population is thickest in a shaly country and partly because the material for surfacing is near at hand and easily obtained.

In places the Marcellus and Hamilton Shales prove suitable for a low-grade brick and for tile, and in the terraces along the rivers are places where clay is suitable for brick. The following are three analyses supplied by B. B. Kaplan that serve as samples of these three clays, including an analysis of Marcellus Shale that is better for brick than the sample mentioned in the paragraph entitled "No Coal":

	Hamilton Shale. Per cent.	Marcellus Shale. Per cent.	Terrace. Clay. Per cent.
Silica (SiO_2)	50.78	55.80	83.41
Ferric Iron (Fe_2O_3)	10.53	23.30	3.19
Alumina (Al_2O_3)	37.04	9.92	7.20
Lime (CaO)	Trace	0.77	Trace
Magnesia (MgO)	0.18	0.45	0.65
Potassium (K_2O)	----	----	0.81
Sodium (Na_2O)	----	----	0.82
Phosphoric Acid (P_2O_5)	0.16	0.43	Trace
Loss on Ignition	2.10	9.36	3.56
Moisture	----	0.74	----
Totals	100.79	100.77	99.64
Fusing Point			2750° F.

The red Catskill Shale is too siliceous for a good brick clay. The following is an analysis of such clay from the State Survey Report on Tucker County, page 242:

	Per cent.
Silica (SiO_2)	67.79
Ferric Iron (Fe_2O_3)	6.36
Alumina (Al_2O_3)	14.52
Lime (CaO)	0.66
Magnesia (MgO)	1.08
Potassium (K_2O)	2.79
Sodium (Na_2O)	0.73
Titanium (TiO_2)	0.63
Phosphoric Acid (P_2O_5)	0.10
Moisture	1.55
Loss on Ignition	3.48
Total	99.69

The Catskill Shale is widely exposed. It forms the area in which are located Levels, Three Churches, Pleasant Dale, the valleys both east and west of Spring Gap Mountain, Nathaniel Mountain, and the valleys both east and west of Short Mountain. Much of the Catskill is a reddish-brown sandstone.

The light-buff Niagara Shale seems suited for brick, but it is not well exposed where it is accessible, as in Mill Creek Mountain west of Sector.

One peculiar deposit deserves special mention. It is the bed of silt that is found in the upper parts of the valley of Castle Run. To the eye and to the touch this clay appears to be kaolin with a very faint yellowish tint. On burning it becomes a buff brick with fusing point at 2851° F. Thus it is too low in fusibility for a fire clay. Its location is too far from easy transportation to market to make the mining of it a financial success. Sometime, when transportation facilities have improved and a denser population is not far distant, this light-colored clay will be ready for use. It is suitable for an excellent buff pressed brick. The analysis is as follows, made by B. B. Kaplan:

	Per cent.
Silica (SiO_2)	65.20
Ferric Iron (Fe_2O_3)	1.80
Alumina (Al_2O_3)	22.82
Lime (CaO)	0.32
Magnesia (MgO)	1.10
Potassium (K_2O)	2.10
Sodium (Na_2O)	1.15
Titanium (TiO_2)	0.32
Moisture	0.19
Loss on Ignition	4.45
Total	99.45

Softening Temperature, 2796° F., or Seger cone No. 20.
Fluid or Flowing Temperature, 2851° F.

"The softening temperature was determined in a reducing atmosphere and gives the lowest possible results.

"This clay burns to a buff color. It is at the bottom of the list of semi-refractory clays, cones 20-27 being considered semi-refractory."

Mr. Kaplan further comments:

"It can not be used as a fire clay, but may be used advantageously in making terra-cotta which is buff-colored, and which is burned at a temperature between cones 6 and 8. It may also be used for making pressed buff brick and for clay sewer pipe."

IRON ORE.

The remains of Bloomery Furnace and of mining in the hills to the west remain as evidence of an early industry active a century ago. The early inhabitants came across the Clinton Iron Ore in the hillsides and in the stream gravels. When iron was high and labor cheap, the early operators could profitably prepare their charcoal, collect their limestone and ore and smelt the ore. Conditions now are different. Ore is easily shipped by train and steamer from the great deposits near Lake Superior to South Chicago and to Pittsburgh where other great industries center, where fuel and limestone are abundant or easily obtained. Against prices established by such wholesale methods profitable smelting at Bloomery is impossible. Fragments of the ore are to be seen on the south slopes of Cacapon Mountain, along the ridge a mile east of Bloomery, along the National Road over North Mountain, from Capon Springs through the Shenandoah National Forest, where it crosses the Clinton outcropping along the west side of North Mountain near the crest. Farther west in the county the Clinton Iron Ore is deep in the ground, covered by other deposits.

The following analyses are of two samples picked up at the old mines at Bloomery Gap. The samples are so different as to suggest two grades of purity in the deposits, one of which is especially good. The analyses are by B. B. Kaplan, Chemist of the State Geological Survey:

Iron Ore, Bloomery Gap.

	Lab. No. 2922. Per cent.	Lab. No. 2923. Per cent.
Silica (SiO_2)	15.00	5.90
Ferric Iron (Fe_2O_3)	65.82	72.80
Alumina (Al_2O_3)	6.80	8.06
Lime (CaO)	Trace	Trace
Phosphoric Acid (P_2O_5)	0.60	0.24
Loss on Ignition	11.55	13.05
Totals	99.77	100.05
Metallic Iron	46.10	51.00

Other analyses may be found in an earlier report: Volume IV, West Virginia Geological Survey (1909).

About three-fourths of a mile northwest of Mechanicsburg, a peculiar decomposing fossiliferous sulphur-bearing stone in the bed of Large Meadow Run was collected for analysis. The stratum is about a foot thick, of the Genesee Series. On this sample, Mr. B. B. Kaplan reports as follows:

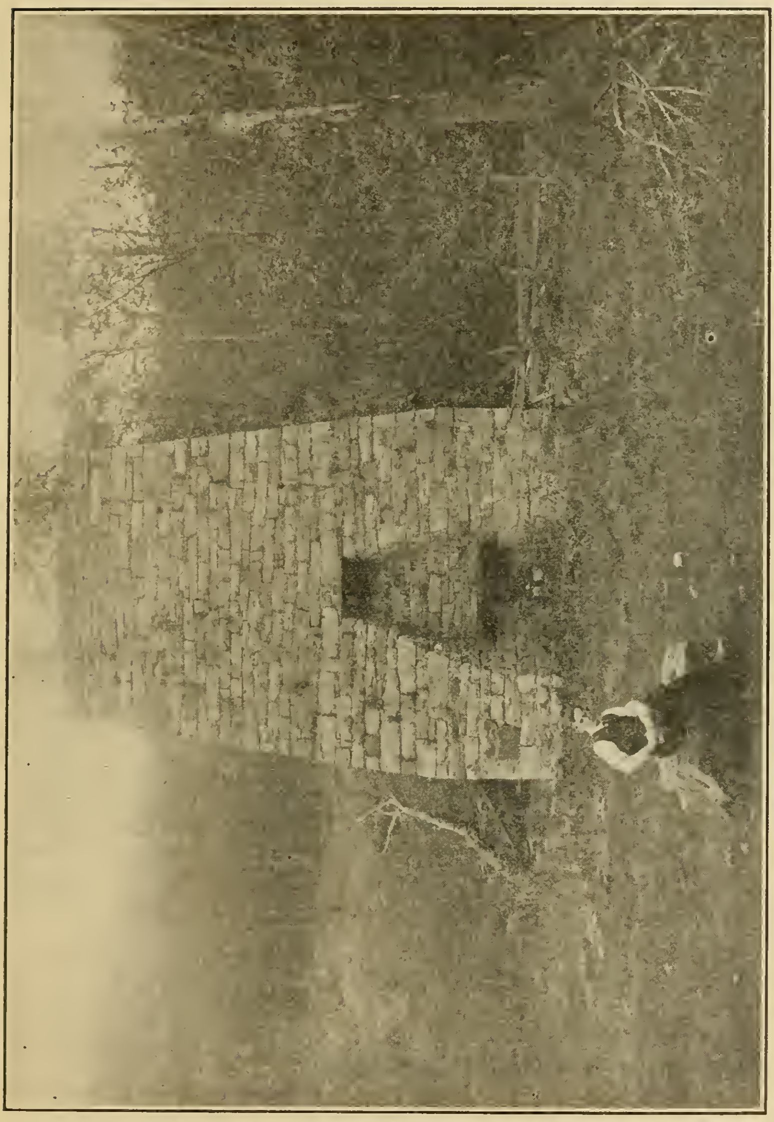

PLATE XXV.—The old furnace at Bloomery Gap.

	Lab. No. 2788. Per cent.
Silica (SiO_2)	19.38
Metallic Iron (Fe)	33.00
Alumina (Al_2O_3)	20.00
Manganous Oxide (MnO)	Trace
Sulphur (S)	27.00
Titanium (TiO_2)	Trace
Phosphoric Acid (P_2O_5)	Trace
Moisture	0.30
Total	99.68

"The iron and sulphur according to the percentages of each found are probably combined in the form of FeS and FeS_2. According to calculation, we have: FeS 32.6 per cent. and FeS_2 27.4 per cent."

In Hampshire County the Oriskany Sandstone contains much more iron than farther north and less than reported from counties farther southwest, but no place was observed where it was thought the Oriskany contained sufficient iron ore to consider it an ore.

An Estimate of the Quantity of Iron Ore.

The iron ore that is in the county is confined to the Clinton Series. This series skirts the flank of Cacapon Mountain for a distance of six and three-fourths miles, dipping away from the mountain. To the southwest it rises to the surface of a secondary fold along which it outcrops for a distance of about five miles (including one and a half miles of the east limb). Between these lines there is a V-shaped area of about a square mile where the Clinton is not far beneath the surface. To the southeast of Cacapon Mountain, at a point directly east of Bloomery, the Clinton lies at the top of an anticlinal hill in an area one and a half miles long and a quarter of a mile wide; but from this area a portion has been removed by erosion. In the valley toward the northwest toward Cacapon Mountain there is an additional area of three-quarters of a square mile where the Clinton is not far from the surface in the syncline.

Along the west flank of North Mountain, east of Capon Springs, it outcrops for a distance of six and three-fourths miles, dipping steeply to the northwest.

In two other regions in the county the Clinton is not far beneath the surface. One of these regions is in the anticline running N. 30° E.—S. 30° W. along Cooper Mountain, east of Hanging Rock, and the other is along the anticline in Mill Creek Mountain west of Sector.

Thus the Clinton Series outcrops along a distance of nineteen and a half miles, and is not far from the surface in an additional area of about two square miles. Elsewhere in the county the Clinton Series is deep beneath later formations, or has been eroded away (along the axes of Cacapon and North Mountains).

The Fossil Iron Ore is reported from two layers of variable thickness, with an average thickness estimated at two feet. While the conditions are not favorable for anything like an exact determination of the ore (hematite, or red oxide of iron) somewhat of an estimate may be desirable. Assuming an average thickness of two feet of ore in the areas mentioned (two square miles) and for a distance of 150 yards from the line of outcrops (19.5 miles) the volume of ore would be 4,019,056 cubic yards, which at three tons per cubic yard would weigh 12,057,168 tons, of which 3,499,200 tons is in the North Mountain area and the remaining 8,557,968 tons in the Bloomery Gap area. According to the first analysis quoted, 65.82 per cent. of this ore is ferric oxide (Fe_2O_3). This would give 2,303,173 tons of ferric oxide for the North Mountain area, and 5,632,855 tons of ferric oxide for the Bloomery area.

In addition to the above there is a sandstone in the Clinton Series that contains a considerable quantity of iron but the percentage of iron is too low and the amount of silica too high to prove of value under any conceivable conditions.

It should further be noted that ore from the Bloomery Gap area was mined from 1833 to 1875, and from 1880 to 1881, since which time the furnace has been shut down. There is no record of the amount of ore removed, but the hill where the Clinton outcrops a mile east of Forks of Cacapon still shows evidence of extensive mining.

WATER.

With this most important mineral of all, Hampshire County is excellently supplied through its rivers, its abundant springs, and its wells.

WATER-POWER.

In the discussion of stream gradients in the Chapter on History of Topography, it was remarked that the facts used would be cited again when the subject of water-power was considered. The problems will be treated as local problems for Hampshire County.

1. For a power site large enough for municipal purposes something more than stream gradient is needed, though stream gradient is important, for a steep gradient makes it possible to construct a dam on resistant strata at the head of the steep gradient and obtain a fall by running the water down the valley through a chute to where the desired fall is obtained and a location found for the mill or power-plant.

A number of sites are available above Largent on Cacapon River. Between Forks of Cacapon and Largent there is a fall of 75 feet; so that a dam 50 feet high erected there would not flood farm land at the Forks of Cacapon. There are, however, rumors that a large dam may at some time be erected near the mouth of Cacapon River that would flood this part of Cacapon River. In the gorge at and above Castle Rock are good foundations for a dam. From Darbys Nose to Forks of Cacapon the river drops 100 feet in five and a half miles. At Rio on the North River there is a fall of 200 feet in three and a half miles. At Mill Creek Gap a fall of 100 feet can be obtained in a distance of about one mile. This locality is already occupied, the dam being placed near the center of the gap, from which point the water is conducted to a power-house 3500 feet farther down stream. About a mile above Sector a fall of 35 feet could be obtained by a dam across South Branch without flooding the farm land near McNeill. Near Purgitsville also there is a marked fall, though shaly strata and a restricted drainage area are not very favorable for a local power site. The first difficulty can be met by care in construction of the dam; the second by supplementary steam power when the water is low.

2. In addition to a considerable fall another condition of importance is a good foundation—which is generally met by conditions where the stream has a steep gradient.

3. The area to be flooded should be one that is not already a valuable farming or town site. This is why a dam higher than 35 feet is not advisable in the "Trough" just above Sector. This also limits the height of a dam at Rio, but a fall is obtainable by conducting the water in a canal or chute to some desirable point below the dam.

4. To equalize the flow the mountain slopes should be well wooded, not deforested. Thus the Shenandoah National Forest is of value not only as a timber preserve but as a regulator of flow for both Cacapon River and the Potomac. The area of precipitation and the area of forestation take one far beyond the bounds of Hampshire County, for Hampshire County profits by all the forests along the Cacapon and along the South Branch clear to their sources. The water

that falls in ravines and open spaces in the mountains is sure to raise the main streams rapidly to the flood stage. The excess of this danger can be avoided by preventing the complete deforestation of the mountainsides. At the same time the river flow becomes more uniform and extreme low water is prevented. It is the flow available at low water that is most important for power. The floods must be allowed to escape without damage to the dam and power-house.

5. The location of reservoirs also serves to equalize the water flow. Hampshire County will be directly benefitted by the presence of a reservoir on the site selected near Petersburg when that project is carried out.

6. The backwater from a dam should not inundate a limestone region because of the possibility that underground drainage may already exist or soon develop that would drain away the ponded water. This is the danger point for a dam placed where the splendid foundation appears at Castle Rock, for Bossardville Limestone dipping to the northwest might afford passageways that could drain underground across to North River. If, however, a dam were placed two and a half miles straight south from Castle Rock, the flooded area would be outside of the limestone area. Here a fall of 35 feet could be obtained without flooding the valley as a whole above Darbys Nose.

THE RESULTS OF GAGING THE RIVERS.

South Branch River has already been gaged by the United States Geological Survey. The methods used are described in full in "Water-Supply and Irrigation Papers" Nos. 94 and 95, and data obtained reported in "Water-Supply and Irrigation Paper" No. 192, pages 38, 68-77, and 90. A summary of the data there given is here included. The water-power obtained is recorded in Forest Service Circular No. 144, page 12, and location of reservoirs mentioned on page 10. Such information is also included in James Morton Callahan's "Semi-Centennial History of West Virginia", pages 391-6, 434, and 436.

Mean Precipitation at Romney, W. Va., 1901-1905.
(Bulletin 192, page 38).

January	2.29	July	4.34
February	1.78	August	3.99
March	3.04	September	1.59
April	3.13	October	2.36
May	3.77	November	1.80
June	3.78	December	2.91
Annual	34.78		
10-year Mean	35.09		

Minimum Discharge of South Branch near Springfield for the months of July to October, in second feet.[1]

	1894	1895	1899	1900	1901	1904	1905
July	210	240	140	170	170	315	702
August	180	132	170	110	205	96	372
September	180	80	170	110	240	78	78
October	----	80	170	110	205	78	125

During the four years (1900, 1901, 1904, and 1905) for which the record is complete, the run-off averaged 35.5 per cent of the precipitation.[2]

On September 26, 1897, the area of the cross-section of South Branch a short distance above the bridge near Romney was found to be 91 square feet, the mean velocity 2.25 feet per second, and the discharge 205 second-feet. On the same day the discharge at Mill Creek near its mouth was 3 second-feet.

Circular 143, page 10, gives the location of a selected site for a reservoir at Petersburg with catchment area of 460 square miles where the mean annual run-off is 1.12 second-feet and the flow available 520 cubic feet per second. The height of dam for the reservoir would be 134 feet, the area of flow line, 7,600 acres, and the capacity of the reservoir 18,550 million cubic feet. This is the only reservoir site selected that directly affects Hampshire County. On page 12 of the same circular the information in the following table is given:

---

[1]Cubic feet per second, from Bulletin 192, pages 75-77. Much more of detail is given in the tables to which reference is made.

[2]The report of the National Conservation Committee, February, 1909, page 21, allows 50 per cent. for evaporation, based on results of evaporation experiments. That leaves 14.5 per cent. as the part of the precipitation that was consumed in some other way, especially by the vegetation.

	South Branch from Mouth to Romney	South Branch from Romney to below Junction of Moorefield River
Length, miles	29.6	24.0
Mean drainage area, sq. mi.	1450	1300
Minimum discharge, Sec.-Ft.	189	169
Minimum discharge during high-water months, Sec.-Ft.	653	585
90% of total fall, feet	114	136
Minimum horse-power	1960	2090
Minimum horse-power during high-water months	6770	7230
Horse-power available from storage during:		
a period of 12 months	5400	6430
a period of 6 months	10800	12860
a period of 3 months	21600	25720

In computing the horse-power it is assumed that 80 per cent. of the power is used. The figures in the above table give the data from which to estimate the horse-power available at a dam erected about a mile above Sector with a fall of 35 feet, 90 per cent. of which is 31.5 feet, which is 23 per cent. of the 136 feet. 23 per cent. of the horse-power available is as follows:

Minimum horse-power	Minimum horse-power during high-water months	Horse-power available from storage during a period of:		
		12 months	6 months	3 months
481	1,663	1,479	2,958	5,916

For Cacapon River the figures available were obtained one-half mile above the mouth of that stream near the town of Great Cacapon, hence include a volume of water received after the river leaves Hampshire County. The area of the cross-section of the river near the town of Great Cacapon is 123 square feet, the mean velocity 0.66 feet per second, and the mean discharge 81 second-feet, which is apparently the minimum discharge. It was said to have been obtained when the river was exceptionally low. The minimum discharge for South Branch is 653 second-feet. An estimate that is worth while can be based on the assumption that a fifth of the area drained is north of Hampshire County. With such an assumption the minimum volume of water at Largent would be 65 second-feet.

On the same day that data were obtained for Cacapon River (September 29, 1897), the discharge of Little Cacapon River was also obtained. The area of the cross-section of this river is 2 square feet, the mean velocity of the water 0.89 feet per second, and the discharge 1.8 second-feet. These data are the basis for the following computation of the minimum water-power given in the following table:

	Total Fall Feet.	90% of Fall.	Minimum discharge in second-feet.	80% of minimum horse-power.
At Largent -----	50	45	81	41
At mouth of Little Cacapon-	25	22.5	1.8	3.6

In all such estimates as are given above it should be borne in mind that power up to the minimum horse-power during the six high-water months can be used and the difference between that power and the minimum found be supplied in time of need by steam or gasoline. The data for such estimates are available only with reference to South Branch.

Power sites on a very small scale are available on Little Cacapon, Capon Spring Run, Mill Branch, Edwards Run, and numerous other runs where the owner can if he wishes select a site suitable for a small dam where sufficient power for his needs are available for a considerable portion of the year. The difficulty here is to avoid disastrous effects of floods. This can be accomplished by the construction of a canal or chute leading downstream to the valley side. Here is a chance for the owner to exercise his ingenuity in the construction of a home-made water-wheel, and thus save for local use some of the power that on every hand is going to waste. A common solution of the power problem is often sought by the use of steam boiler and engine, refuse fragments from a sawmill serving for fuel.

SPRINGS.

The most noteworthy spring, at least historically, is Capon Spring, in the southeastern part of the county. Here there was a remarkable resort for many years before the Civil War, with baths, swimming pool, fine spring water,

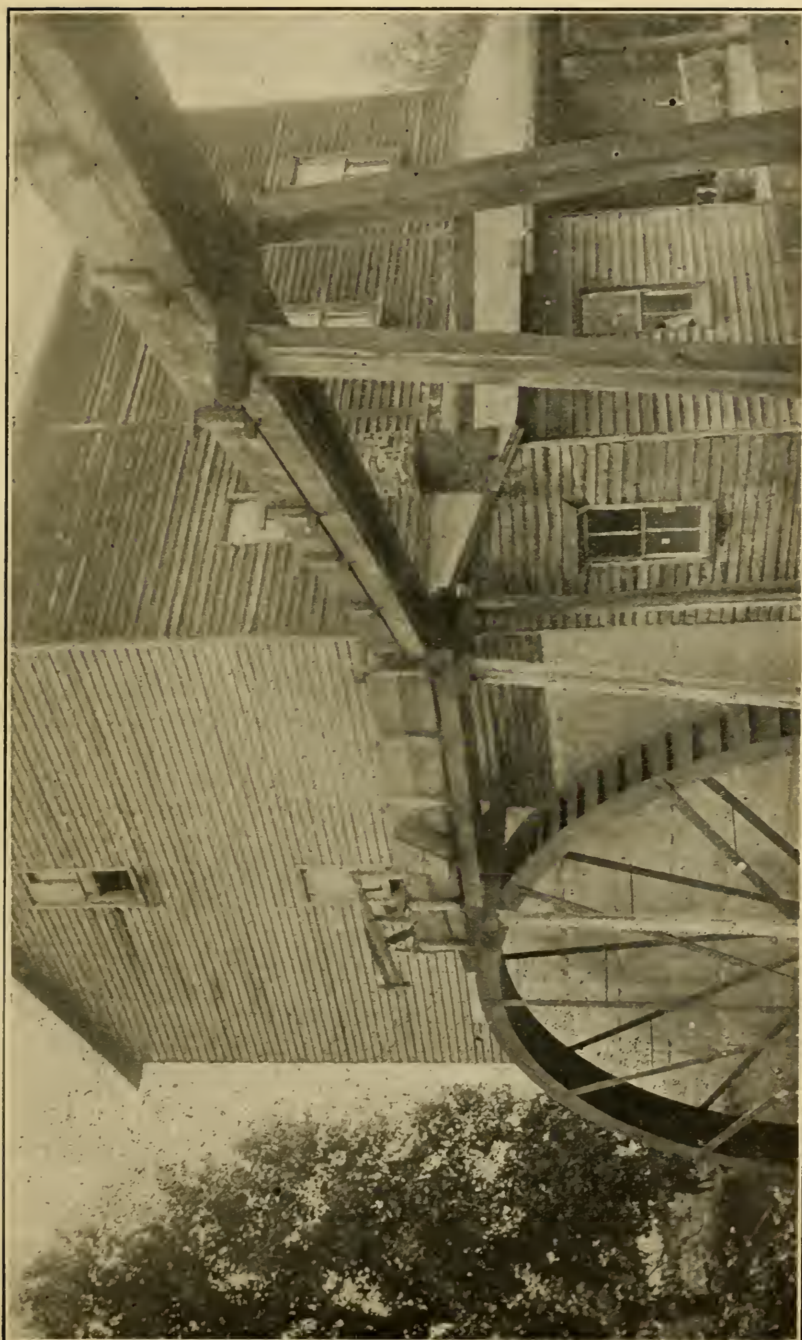

PLATE XXVI.—The thirty-foot overshot wheel that runs the grist-mill at Yellow Spring.

and with sumptuous hotel and numerous cottages nestling in a wooded valley near a cliff of Oriskany Sandstone standing on edge. This center of former gaiety still has its cottages but the hotel is gone, destroyed by fire. At present there are bottling works from which the pure water is shipped to eastern cities. Maxwell and Swisher in their "History of Hampshire County" record the capacity of the spring as 6,000 gallons per hour at a temperature of 64° Fahr., and state that "the water is what is known as alkaline lithia, and as it flows from the earth has a saponaceous feel. The qualitative analysis of the water shows that it contains silicic acid, soda, magnesia, bromine, iodine, and carbonic acid. . . . . There is also a chalybeate spring about three-quarters of a mile from the main spring."

Some day with good roads for automobile travel this beautiful glen may again become a rendezvous as of yore. The grove, the spring, the towering cliff, the mountain road through the Shenandoah National Forest to the deep valley beyond are still here as inviting as ever.

A second spring worthy of note is in Mill Creek Gap where the water comes from Mill Creek Mountain. A short distance below this point an old mill was converted into a pumping station in 1912, where by the use of water-power obtained by damming Mill Creek the spring water is pumped to a reservoir that supplies Romney.

Mr. J. C. Linthicum, the City Engineer in charge of the plant, gives the following data:

Capacity of reservoir, 115,000 gallons.

Height of reservoir above pump, 390 feet.

Height of reservoir above town, 160 feet.

Water used per day, 75,000 gallons, supplying 275 houses and 14 hydrants.

The capacity of the spring is 390,000 gallons per day.

There has been no analysis of the water but it is considered a hard limestone water.

From a low dam 3,500 feet up Mill Creek from the pumping station the water is conducted to the mill where there is a fifteen-foot drop past an overshot wheel, used to generate electricity, which is now used in the pumping and in lighting the town.

A twelve horse-power Fairbanks-Morse gasoline engine is held in reserve. There are two pumps: a Gould and a Deming; capacity: one 65 gallons per minute, the other 50 gallons.

The plant is a municipal plant and is now self-supporting, the cost per month being $115. for electricity, $60. for wages, and 5 per cent. commission to collect the water charges.

In 1912 the city was bonded for $15,000 for twenty years at five per cent. Up to date all that has become due (over half) has been paid.

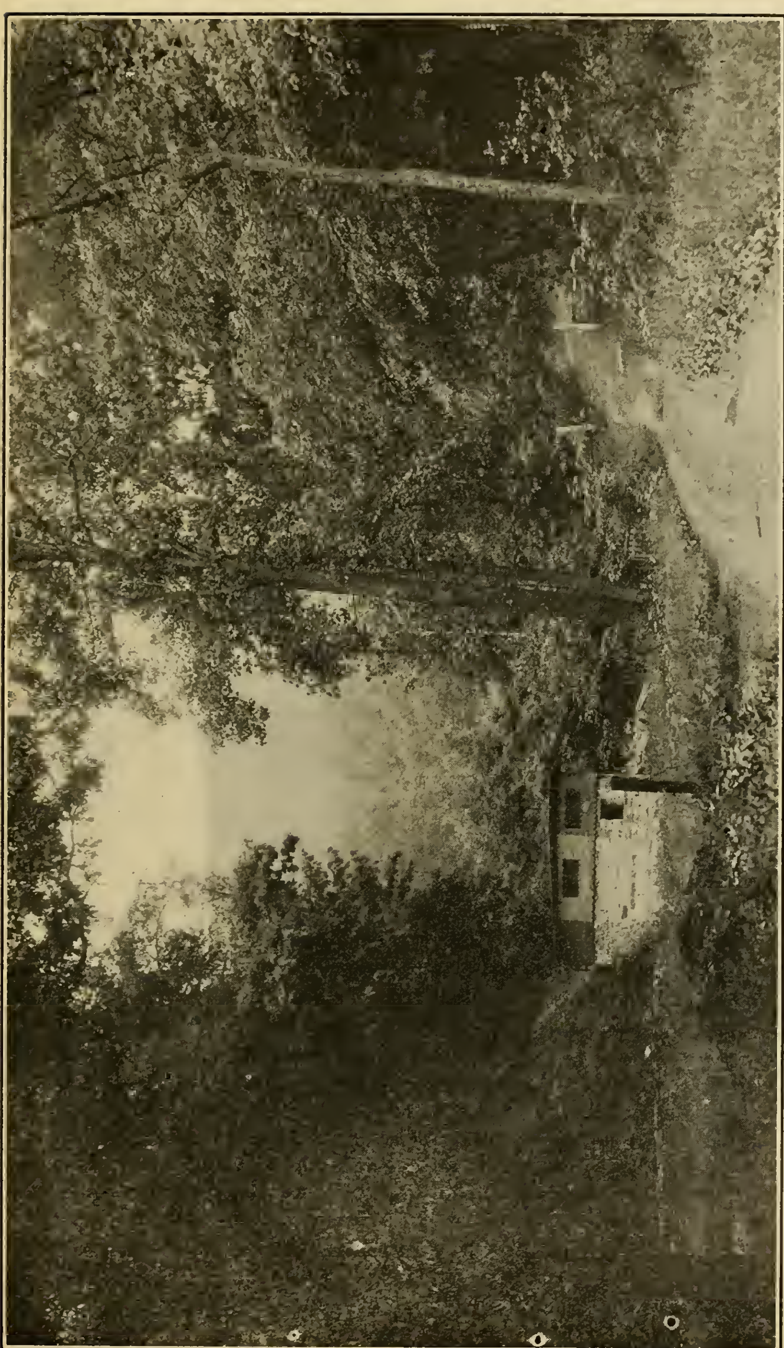

PLATE XXVII.—Capon Spring. (See page 138 for description of plate).

DESCRIPTION OF PLATE XXVII.—Capon Spring. Oriskany Sandstone rises vertically on the left just behind the spring-house, and on the right by the road, leaving a gate-like gap through which a Government road goes southeast over North Mountain to Virginia. In the background is North Mountain, made by the arch of White Medina Sandstone, along the crest of which lies the boundary between Virginia and West Virginia. Between the vertical Oriskany Sandstone in the foreground, and the White Medina Sandstone in the background along the crest of North Mountain, rise all of the intermediate strata in order.

This is a good illustration of what community cooperation can accomplish under good leadership. The city is now supplied with sewer, lights, and water.

A third spring is known as **Crystal Spring,** about three and a half miles south of Capon Bridge. Here near the base of Oriskany Sandstone the water bubbles up in the bottom of a large spring protected by a spring-house, and flows away as a brook across the lower ground toward Cacapon River.

Bubbling Spring.—The traveller who under the guidance of Mr. C. N. Loy climbs Castle Rock is sure to go farther along the remarkable valley and see "Bubbling Spring" pour out from the hillside and run over the thick bed of travertine into a delightful pool along the swift Cacapon River.

At Mechanicsburg water from a spring on the mountain-side is piped to the colonial homestead of Mr. James S. Taylor close by, where, in the house, it supplies both kitchen and bathroom and at the milk-house fills a large tank with cold pure water. Near the road it flows in inviting jets for the traveller, and then to the watering-trough below for horses.

Between Romney and Springfield one is sure to notice the spring by the wayside at Grace where it is protected by a cement wall and accompanied by evidence of frequent use by the inhabitants and travellers.

At the south edge of the town of Greenspring water flows from a choice spring at the base of Valley Mountain into a small pond back of a cement retaining wall, and thence out across the valley to North Branch. It is this spring that has given the name to the town.

The above-mentioned springs are but some of the very noticeable ones. Frequently in the county, spring-houses may be seen near the farmhouses where the purest of water is found, and in the mountains the traveller may often refresh himself at springs whose locations are well known to the inhabitants.

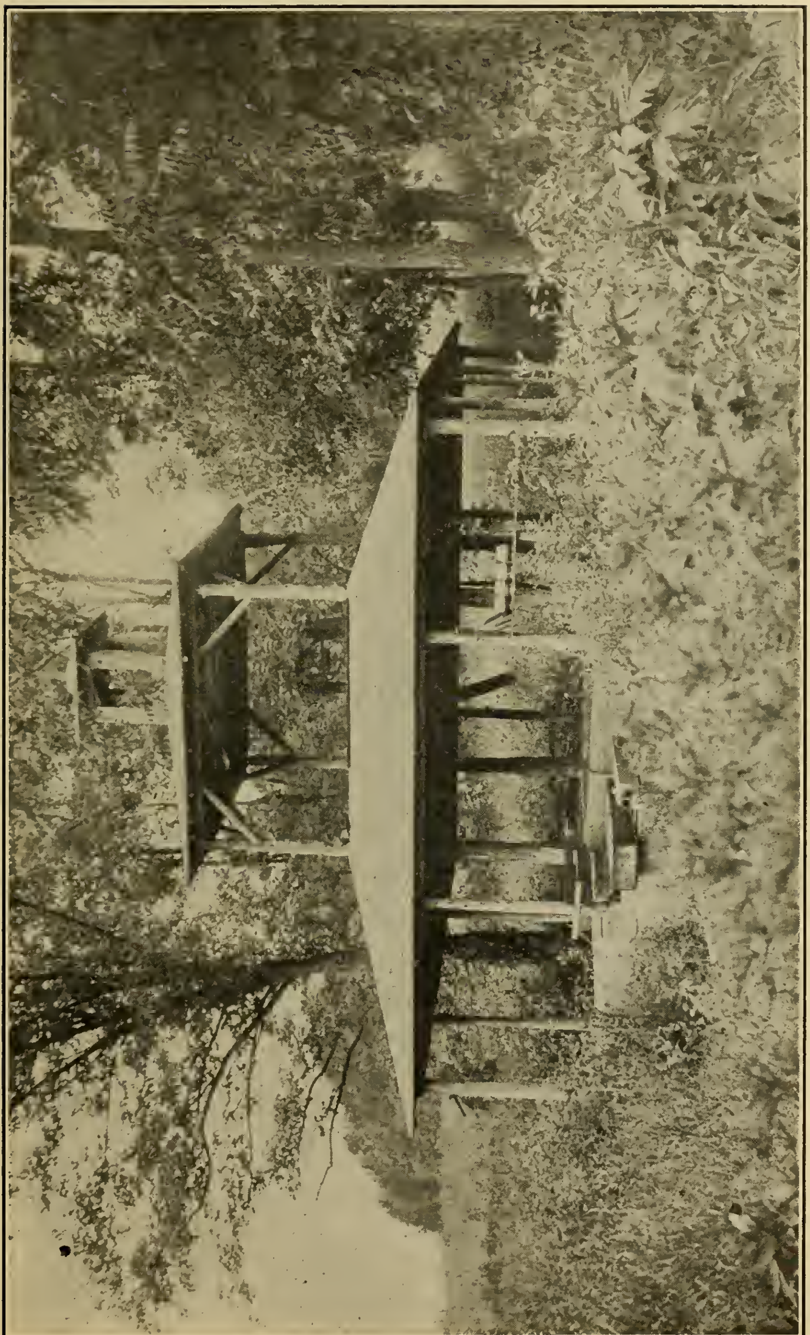

PLATE XXVIII.—Crystal Spring, 3½ miles south of Capon Bridge.

PLATE XXIX.—At "Bubbling Spring" about a mile south of Caudy's Castle (Castle Rock), the water from the spring flows over grass and moss to the river. As the water evaporates, a deposit of marl is left encrusting the vegetation. In the picture the man is standing in the midst of this deposit.

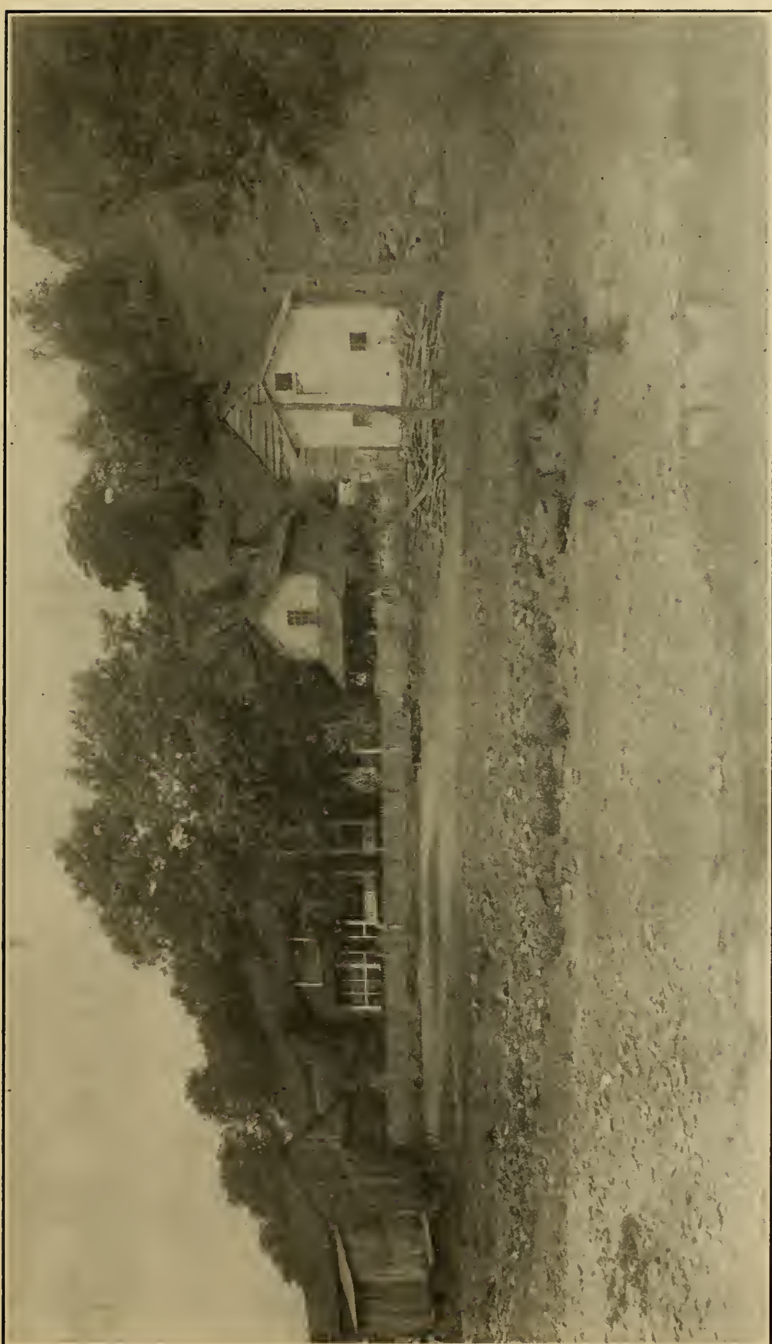

PLATE XXX.—Residence of James S. Taylor at Mechanicsburg. (See page 142 for description of plate.)

DESCRIPTION OF PLATE XXX.—Residence of James S. Taylor at Mechanicsburg. This old homestead has been a notable landmark for over a hundred years. In the early days it was a hotel (wagon stand). Situated as it is at the west end of Mechanicsburg Gap on the road from Romney to Keyser and to Moorefield it was occupied throughout the Civil War first by one side and then by the other. The west end of the house was in constant use as a hospital. To the right of the house and toward the gap a large spring of water gushes from Oriskany Sandstone. The water is piped down to the house, and to the milk-house to the right of the house. From the milk-house the water flows to troughs where the man is standing and then to the watering-trough by the roadside, from which it flows to Mill Creek close at hand, a complete water system.

Wells.—In a region of such numerous springs good well water is of course easily obtained. The main problem is to so plan the surface of the ground around the well and to so cover the well that nothing can get into it from above, not even surface water.

SUMMER RESORTS.

A region of such beautiful scenery, with clear air, pure water, shady mountain nooks and climbs, and with rivers stocked with game fish, is sure to prove an attractive resort to the weary business man who seeks to get back to Nature, and to young people of cities who love the out-of-doors. A ride of a mile east along the foot of the cliff at Grace brings one to the shaded flat where the Cumberland Y. M. C. A. has located its summer camp. Here swimming and canoeing are close at hand under careful supervision. Permanent camps and clusters of tents are common sights at Forks of Cacapon and along South Branch, and a day's trip by auto from any of the hotels and camps will take one to "Table Rock" in the wilds of Cacapon Mountain, to "Caudy's Castle" (Castle Rock), and "Bubbling Spring", to "The Rocks" with their 300-foot cliff, to Hanging Rock Gap and the entrancing view west through the gap from high on the mountainside east, and to the peaceful expanse of the valley at Capon Bridge guarded by mountains. Such scenery is an asset for Hampshire County the value of which will steadily increase, aided by such welcome and care as is already extended to the summer visitor.

TIMBER.

The various kinds of soil, the varied exposure in ravine and on open slope, the frequent rains and yet abundance of

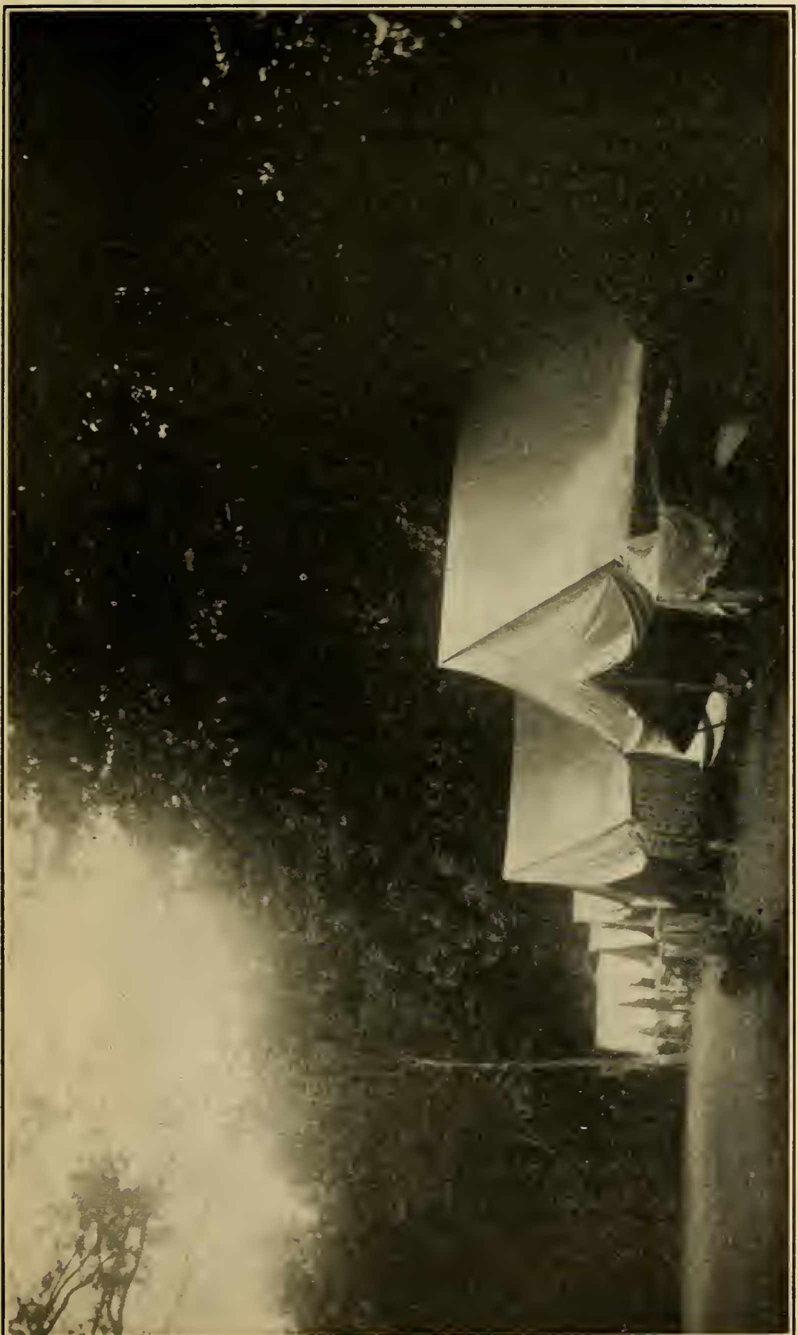

PLATE XXXI.—The Y. M. C. A. Camp near Grace, W. Va.

sunshine, have favored a great variety of trees, among which the various oaks, walnuts, elms, hickories, maples, and pines are most important.

In the early days timber was burned to get it out of the way. Later, timber was cut for the bark, and timber that now would be valuable for dimension lumber left to rot on the ground. Even to-day piles of bark may frequently be encountered in the mountainous parts of the county standing by the roadside or carried on wagons toward shipping points, or toward the large tannery located at Pawpaw; but the timber is no longer wasted as formerly. Load after load of railroad ties are constantly seen on their way to shipping points for Greenspring, where in the great yards a million ties may be seen at one time awaiting treatment in the creosoting tanks. Of the 2,750,000 ties which the Baltimore and Ohio Railroad requires each year about half are treated with creosote at Greenspring at the rate of 4,000 per day. The working-life of a tie is thus increased to twelve or fifteen years, two and a half to three times the life of a tie that had not been thus treated.

Somewhat of dimension lumber is still collected at Romney and shipped out. Much of the smaller sizes of oak and other timber is cut for mine-props, fence-posts, and telephone-poles. These now form a great crop from mountainsides that are of little use for aught save timber. With wise selection this crop can be made continuous and yet so managed that mountainsides will not be exposed to excessive erosion.

The abundance of fruit now raised, especially of apples and peaches, has led to the renewal of an ancient industry. As the harvesting time for the fruit approaches, various saw-mills are busy sawing out barrel staves. These, either knocked down or set up, are carted to the store-houses of the orchards to await the arrival of the crop. Baskets and boxes for the peaches are now in great demand, for the high ground of limestone and Catskill Shale has proved an ideal location for the growth of fruit trees replacing the early timber.

Unfortunately the chestnut trees, long a source of choice lumber, are disappearing under the ravages of Chestnut blight. Large trees that have not suffered from this plant disease are perhaps never found. In their places the mountainsides look stark and brown; only the saplings look fresh and green. The pine-blister has not yet begun its ravages in this region.

PLATE XXXII.—View northeast from a knoll southeast of Ebenezer Church three miles east of Romney. The weathered Catskill Shale and Sandstone in the foreground is considered choice soil for peach and apple orchards, for which purpose it is used in this locality and north in Maryland.

Native Forest Trees.

The following list is reported in Volume V of the West Virginia Geological Survey, 1911, as identified in Hampshire County:

Pinus strobus L. (White Pine).
Wood soft, straight-grained, easily worked, light, not strong.

Pinus rigida Mill. (Pitch Pine, Bull Pine, Rosin-tree).
Wood coarse-grained, brittle, light, reddish, very durable. Resin-filled knots are frequently found in deciduous woods which have been exposed to the weather for hundreds of years.

Pinus echinata Mill. (Yellow Pine, Short-leaved Pine).
Wood hard, heavy, coarse-grained, yellowish; a valuable timber tree.

Pinus virginiana Mill. (Jersey Pine, Scrub Pine).
Wood soft, light, brittle, coarse-grained.

Pinus pungens Michx. (Table Mountain Pine, Hickory Pine).
Wood coarse-grained, brittle, light.

Juglans cinerea L. (Butternut, White Walnut).
Wood light, soft, coarse-grained, light-brown, durable.

Juglans nigra L. (Black Walnut).
Wood heavy, dark-brown, hard, coarse-grained, durable heartwood.

Hicoria ovata Britt. (Shellbark Hickory, Shagbark Hickory).
Wood heavy, hard, strong, tough, close-grained, flexible, light in color; a very valuable wood.

Hicoria alba Britt. (Mockernut, Big Bud Hickory).
Wood similar to that of Hicoria ovata.

Hicoria glabra Britt. (Pignut).
Wood similar to that of Hicoria ovata.

Populus deltoides Marsh. (Cottonwood).
Wood brownish, with white sapwood, difficult to season.

Carpinus caroliniana Walt. (Hornbeam, Blue Beech, Water Beech).
Wood close-grained, heavy, light-colored.

Ostrya virginiana K. Koch. (Hop Hornbeam, Ironwood).
Wood very hard, close-grained, heavy, durable.

Castanea dentata Borkh. (Chestnut).
Wood soft, light, coarse-grained, not strong, durable in contact with the ground, light-brown.

Quercus rubra L. (Red Oak).
Wood hard, heavy, medium close-grained, reddish-brown.

Quercus coccinea Moench. (Scarlet Oak, Pin Oak).
Wood hard, heavy, coarse-grained, light-brown.

Quercus velutina Lam. (Black Oak, Yellow-bark Oak).
Wood hard, strong, coarse-grained, reddish-brown.

Quercus nana Sarg. (Bear Oak, Scrub Oak, Jack Oak).
Wood of no commercial use.

Quercus alba L. (White Oak).
Wood hard, close-grained, heavy, light-colored, durable; very valuable.

Quercus minor Sarg. (Post Oak, Iron Oak).
Wood heavy, hard, close-grained, durable; valuable.

Quercus macrocarpa Michx. (Burr Oak, Mossy Cup Oak).
Wood like that of Quercus alba.

Quercus prinus L. (Chestnut Oak, Rock Chestnut Oak).
Wood heavy, hard, close-grained, light-brown, durable.

PLATE XXXIII.—A part of one of the great crops of Hampshire County on its way to Romney.

Ulmus americana L. (White Elm).
Wood heavy, strong, tough, medium coarse-grained, light-brown; planted extensively as a shade tree.

Celtis occidentalis L. (Hackberry, Sugarberry, Hoop Ash).
Wood soft, coarse-grained, not strong, light-yellow.

Magnolia acuminata L. (Cucumber tree, Mountain Magnolia).
Wood light, soft, durable, light-yellow.

Liriodendron tulipifera L. (Yellow Poplar, Tulip-tree).
Wood soft, light, easily worked, not strong, durable heartwood, light yellow; valuable.

Asimina triloba Dunal. (Pawpaw).
Wood soft, light, weak, coarse-grained, light-yellow.

Sassafras sassafras Karst. (Sassafras).
Wood soft, brittle, coarse-grained, durable, dull-yellow; roots and bark supply oil of sassafras.

Hamamelis virginiana L. (Witch Hazel).
Wood heavy, very hard, close-grained; bark used as a medicine.

Platanus occidentalis L. (Sycamore, Buttonwood).
Wood hard, close-grained, light-colored.

Malus coronaria Mill. (Crab Apple. Fragrant Crab).
Wood hard, close-grained.

Amelanchier canadensis T. and G. (Shad Bush, Service Berry).
Wood heavy, very hard, close-grained, brownish; berries edible.

Crataegus crus-galli L. (Cockspur Thorn).

Prunus americana Marsh. (Wild Plum).
Wood heavy, close-grained, dark.

Cercis canadensis L. (Redbud, Judas-tree).
Wood heavy, hard, weak, close-grained, reddish; ornamental.

Robinia pseudacacia L. (Locust, Acacia, Yellow Locust).
Wood heavy, very hard, strong, durable, brownish with pale-yellow sapwood.

Rhus hirta, Sudw. (Staghorn Sumach).

Acer saccharum Marsh. (Sugar Maple, Rock Maple).
Wood strong, hard, heavy, close-grained, reddish; sugar.

Acer saccharinum L. (Silver Maple, Soft Maple).
Wood hard, rather brittle, easily worked, close-grained, brownish.

Acer rubrum L. (Red Maple, Scarlet Maple).
Wood medium-heavy, close-grained, soft, light-brown.

Tilia heterophylla Vent. (Linden, Bee-tree).
Wood light, soft, light-brown.

Nyssa sylvatica Marsh. (Tupelo, Pepperidge, Black Gum).
Wood heavy, tough, medium coarse-grained, light-yellow.

Cornus florida L. (Flowering Dogwood).
Wood heavy, close-grained, hard, brownish.

Diospyros virginiana L. (Persimmon).
Fruit edible.

Fraxinus americana L. (White Ash).
Wood heavy, strong, close-grained; valuable.

Viburnum prunifolium L. (Black Haw, Stag Bush).

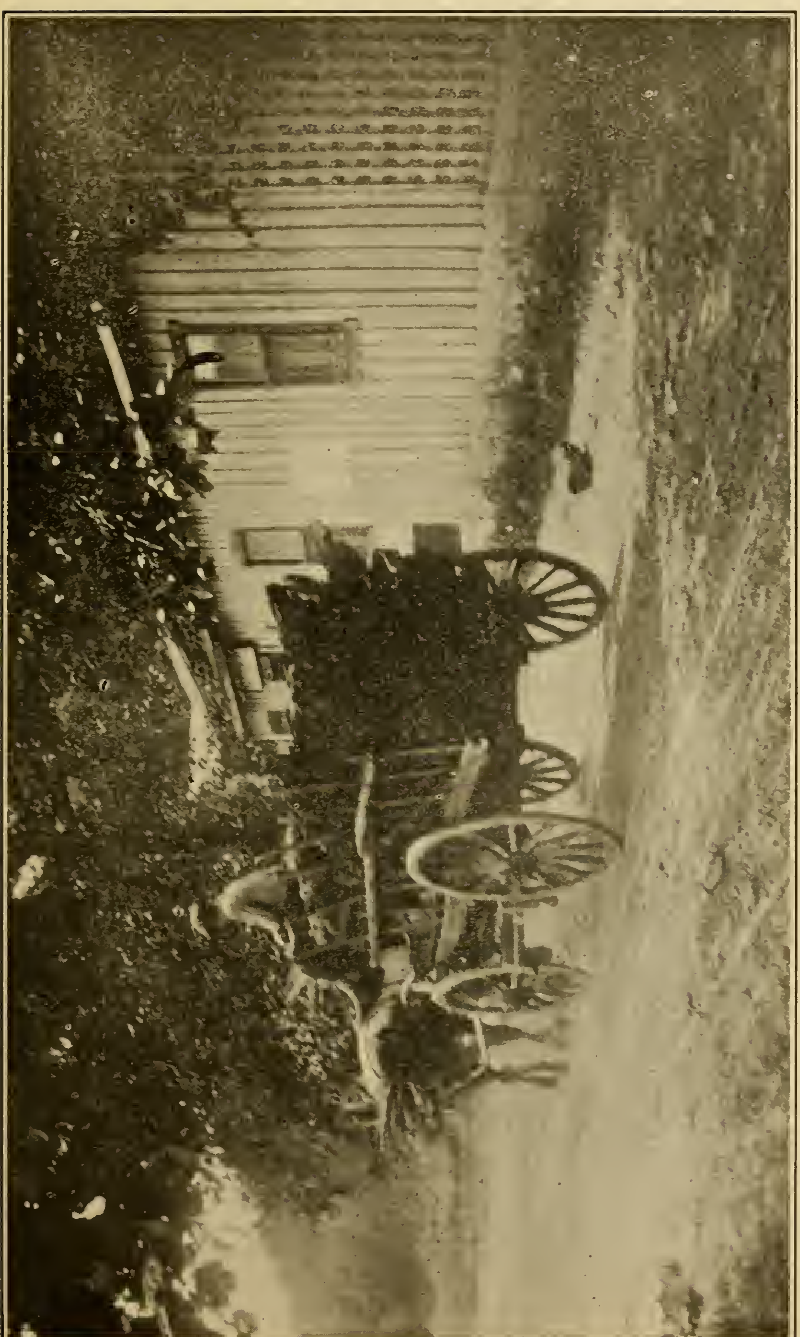

PLATE XXXIV.—A load of bark near Sector, W. Va. A part of one of Hampshire County's great crops.

Original Timber Conditions.

In 1911, the West Virginia Geological Survey published Volume V on Forestry and Wood Industries, the author being A. B. Brooks. In the description of timber conditions in Hampshire County, he writes as follows under the above heading, pages 151-2 of the report mentioned:

"Despite the fact that the county was settled at an early date, most of the timber cut before the building of the branch railroad from the main line to Romney in 1884 was destroyed by fire or used for domestic purposes. For this reason much practically virgin timber was standing 30 years ago, and several of the less valuable virgin tracts have been preserved to the present day. The men who remember the undisturbed forests of the valleys and fertile hills speak of them as 'excellent timberlands', containing large numbers of such trees as the oaks, walnuts, elms, hickories, maples, and pines. The principal softwood was yellow pine, though this did not grow in pure stands, generally. White pine was often found but was said to be of an inferior quality. Scrub pine was abundant, especially in poor, gravelly soils; and the other two indigenous pines, as well as red cedar and hemlock, grew in small numbers locally."

Early Settlements and the Lumber Industry.

Under this heading, Mr. Brooks writes as follows, pages 152-153 of Volume V, above mentioned:

"George Washington speaks of 'a great company of people, men, women, and children, who followed us through the woods' when he was surveying in the South Branch Valley in the spring of 1748. The 'people' referred to—who all spoke 'dutch'—were Germans who had settled this region at that early date in considerable numbers. That is, settlement began in the county over 150 years ago. For the first 100 years, at least, there was little timber cut for commercial purposes; but vast quantities were necessarily destroyed by fire during this period and much was used for various purposes about the pioneers' homes. Mr. I. H. C. Pancake, of Romney, states that in an early day there was no general shipment of lumber out of the county and that most of the lumber for home use was sawed on the old-time water sawmills, several of which were located on the streams at various points. In 1835 there were 9 of these water sawmills, 1 cabinet maker's shop, 2 wagon maker's shops, 2 chair-making establishments, and 3 tan yards in Hampshire County. The principal lumber sawed on the water mills was yellow pine and a little yellow poplar and other of the softer woods.

"A limited shipment of lumber from the northern end of the county followed the building of the main Baltimore and Ohio Railroad, and before that time there had been some floating done on the South Branch and the Great Cacapon

"From the year 1875 to 1885 considerable lumber was sawed in the vicinity of Romney and traded to merchants for goods. Good yellow pine was valued at $9.00 a thousand feet. A part of this lumber was disposed of to lumber dealers and the rest stacked near the stores and sold in small or large quantities to the local citizens as they needed it. The merchants also took large numbers of white oak shingles 'for trade'.

"An active lumber industry, in which portable sawmills figured prominently, began with the building of the branch railroad before mentioned. Lumber from the portable mills was hauled in wagons and shipped from Romney and other stations on the branch or main-line railroads. For the last 25 years there has been a constant drain upon the remaining forests, and the extensive virgin areas have been reduced to comparatively small and isolated tracts. There are a few active lumber operations at present in the county. Most of the owners of sawmills, however, run their mills irregularly through the winter and in the fall use their engines for threshing grain.

"Two firms located at Romney still ship large numbers of cross-ties, but the trade in lumber has fallen off during recent years."

The Present Forest Conditions.

The topographic map accompanying this report on Hampshire County is made up from portions of the Flintstone, Pawpaw, Keyser, Hanging Rock, Capon Bridge, Moorefield, Wardensville, and Middletown Quadrangles. The United States Geological Survey publishes these sheets in two forms, one plain, and the other with green over-print showing all the timbered areas of the county, both virgin and woodlot. Anyone desiring information about any section of the county with reference to timber conditions will find the forest maps of great value. All but the Flintstone and Pawpaw Quadrangles may be procured for 10 cents each with forested areas shown in green by writing to The Director, United States Geological Survey, Washington, D. C. The two sheets mentioned were published about 1900, before the Government undertook to map the timbered regions of the State.

Under the above heading, Mr. Brooks (in 1911) writes as follows concerning Hampshire County's present forest conditions, pages 153-154, of Volume V:

"The virgin forests of the county, which aggregate about 12,000 acres, lie principally toward the southern end and are situated upon the mountains. A virgin forest of considerable extent still remains upon the eastern face of South Branch Mountain a few miles south of Romney; and there are other large tracts on the northern end of Short Mountain, and on Great North Mountain near the Virginia line. The cut-over forests, aggregating about 15,000 acres, are in Bloomery District in the northern end, on the western face of South Branch Mountain, and in smaller areas throughout the mountainous parts of the county.

"Probably one-third of all the land is cleared. Romney District is largely improved; Mill Creek, Springfield, and Gore Districts have scattered improvements; Sherman and Capon Districts have numerous improvements at the bases of the mountains, the farmers' woodlots often extending from their cleared lands to the summits of the wooded mountains. Bloomery District, in the northeastern end, is roughest and least improved. There are, perhaps, 50,000 acres of non-agricultural land in the county covered with a growth of scrubby timber. It should be stated, however, that much land considered almost worthless in the past has been found in recent years to be well adapted to fruit growing.

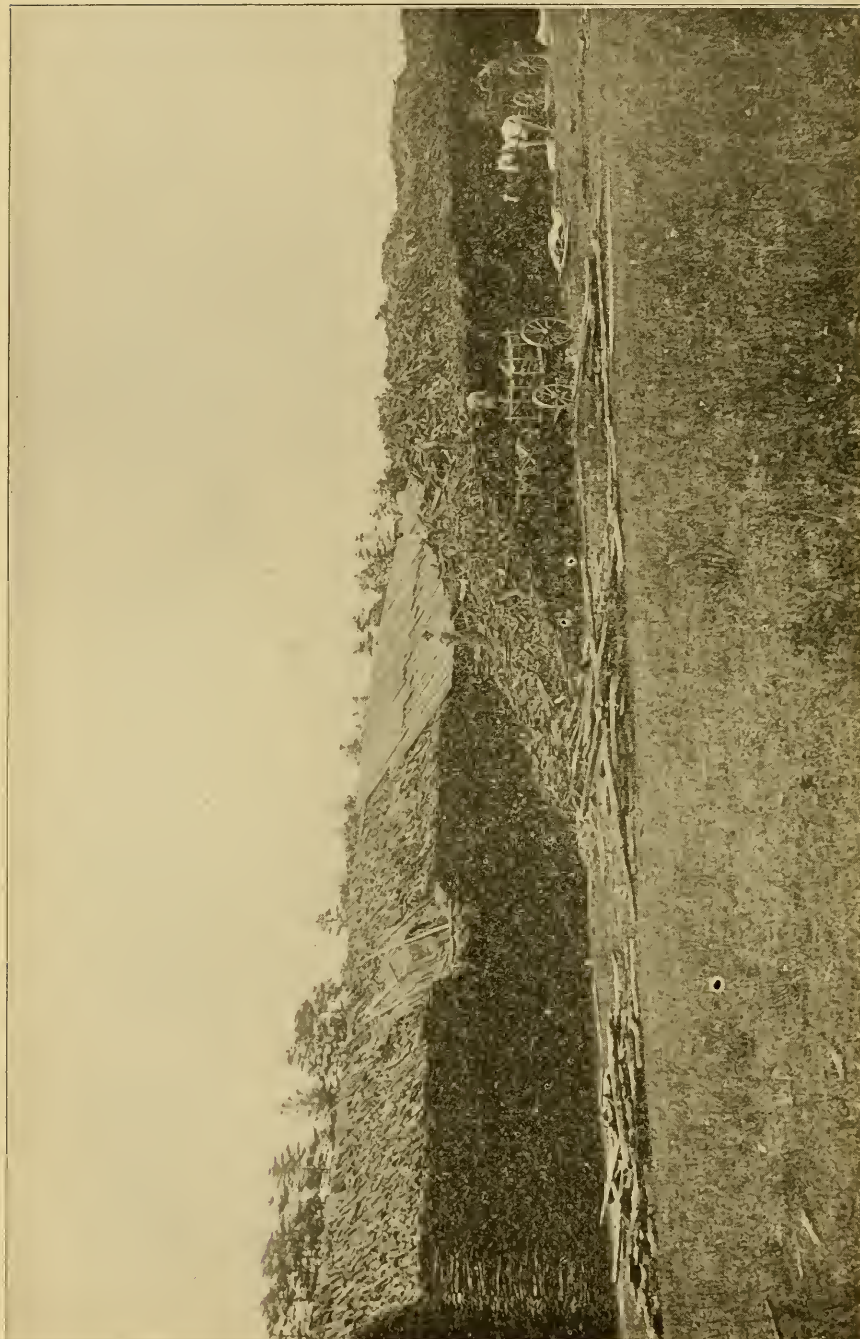

PLATE XXXV.—Stacking Tanbark at Romney, Hampshire C ounty. (Photo. reproduced from page 156, Volume V, of Survey Reports).

"The trees most commonly found on the dry, wooded hills at present are scrub pine, chestnut oak, scarlet oak, scrub oak, and black oak. With these grow scattered locusts, pitch pines, table mountain pines, and a few chestnuts. The lower lands now produce such timbers as white ash, black and white walnuts, white and slippery elms, cucumber, basswood, sugar maple, and many others."

TIMBER PRESERVATION PLANT, GREEN SPRING.

The Survey is indebted to Mr. E. E. Alexander, Supervisor of Timber Preservation Plants, of the Baltimore and Ohio Railroad, for the following description in detail of the plant at Green Spring and also for the plate showing their standard method of piling ties for seasoning and two panoramic views of the plant and yards at Green Spring published as an insert:

"A survey of Hampshire County would be incomplete unless it included at least a brief description of the modern Timber Preserving Plant of the Baltimore and Ohio Railroad Company at Green Spring.

"Designed originally with two treating cylinders for the chemical treatment of cross-ties to prevent decay, construction was completed and operation regularly begun in April, 1913, with a rated capacity of over 1,000,000 ties per year. Enlarged in 1924 by the addition of a third cylinder with the necessary additional equipment, the plant now has an annual capacity of 1,800,000 standard cross-ties or their equivalent with an average employment of 175 men and an average monthly pay-roll of over $20,000 (1925 figures).

"Main Building.

"The main building 175′ x 110′ entirely of concrete and steel construction, practically fire-proof, contains the three immense treating cylinders seven feet in diameter by 132 feet long, of 3/4″ boiler plate steel, with necessary working or solution tanks for the chemicals, machinery, etc., including an experimental plant and chemical laboratory.

"Power is furnished by four 150-horse-power H. R. T. boilers.

"Two oil storage tanks 40′ x 30′ with a combined capacity of over half a million gallons with a third tank 20′ x 20′ for zinc chloride provide ample chemical storage.

"Water supply is secured from the Potomac River.

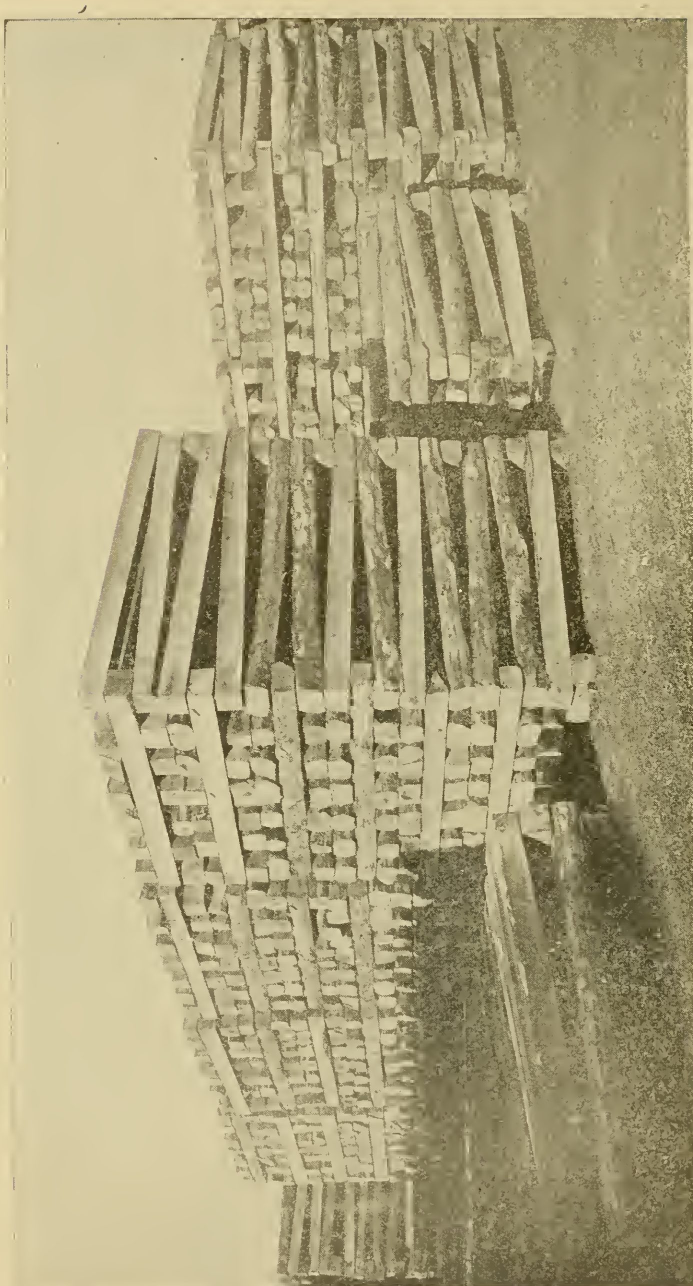

PLATE XXXVI.—Showing standard method of piling cross-ties for seasoning at Baltimore and Ohio Railroad's timber preservation plant at Green Spring.

"Storage Yard.

"The storage yard covers approximately 120 acres, with a capacity of over 1,000,000 ties for seasoning, has over 33,000′ or more than six miles of standard-gauge yard tracks, 20,000 feet of which is fitted with third rail for narrow-gauge use.

"After inspection cross-ties are shipped to the plant and carefully piled for air seasoning, usually held ten to twelve months before treatment. In addition to cross-ties included in the list of material treated at the plant are switch-ties, piling, bridge-ties, and timbers of all sizes, drain-box lumber, snow fencing, tie plugs, and other miscellaneous material.

"A wood-working mill 30′ x 60′ also of metal construction fitted with cut-off and rip saws, gainer, and planer, all electrically operated, was also installed during 1924 since which time practically all bridge-ties are framed to fit bridges before treatment.

"Additional equipment includes one standard-gauge locomotive, one 24-ton narrow-gauge locomotive, and two locomotive cranes.

"Process.

"In the treatment of cross-ties and switch-ties, the 'Card' process, a mixture of creosote oil and zinc chloride, is used; in the treatment of piling, bridge-ties, and timber, straight creosote treatment is given. In either case the method is the same.

"After air seasoning ties are loaded on 30″-gauge tie cars, a train of fifteen of these run into the treating cylinder, and doors hermetically sealed. A high vacuum is then drawn in cylinder, the preservative introduced and forced under high pressure into the wood. At conclusion of treatment a final vacuum is drawn to dry timber and avoid waste.

"Average treating time, hardwood ties six to eight hours, softwood ties four to six hours, timber and piling ten to eighteen hours. If necessary to treat unseasoned material artificial seasoning by means of live steam is resorted to increasing the time required proportionately.

"12,352,000 ties alone have been treated to December 31, 1925."

STATISTICS.

The statistics on the population of districts and towns given below are from the Bureau of Census, 1920. The remaining data are from advance sheets of 1925 farm data collected by the Bureau of the Census, Department of Commerce, Washington, D. C., obtained through the kindness of W. M. Stuart, Director, June 10, 1925, and of Arthur J. Hirsch, Acting Director, August 26, 1926:

Population of Hampshire County.

	1920.	1910.	1900.
Bloomery District, including part of Capon Bridge town	1,222	1,462	1,518
Capon District, including part of Capon Bridge town	1,281	1,424	1,556
Gore District	2,329	2,461	2,369
Mill Creek District	764	763	840
Romney District, including Romney town	2,566	2,313	2,229
Sherman District	1,912	1,959	2,031
Springfield District, including Springfield town	1,639	1,312	1,263
Totals	11,713	11,694	11,806

	1920.	1910.	1900.
Population of Romney	1,028	1,112	580
Population of Springfield	167	135	143

Farm Data.

	1925.	1920.
Number of farmers (total)	1,766	1,663
Native white	1,759	1,649
Foreign born white (1)	----	5
Negro and other non-white	7	9
Farms operated by:		
Owners	1,574	1,390
Managers	27	63
Tenants	165	210
All lands in farms, acres	316,608	322,380
Value of all farm property	$7,152,393	$8,291,584
Land, excluding buildings	$4,151,846	$4,925,957
Buildings alone	$1,726,140	$1,733,303
Implements and machinery	$ 480,422	$ 503,153
Live stock on farms	$ 793,985	$1,129,171

Domestic animals on farms and ranges:

		1925.	1920.
Horses	Number	3,041	3,495
	Value	$ 200,780	$ 282,142
Mules	Number	414	520
	Value	$ 31,360	$ 53,535
Asses	Number (1)	--------	3
	Value (1)	--------	$ 424
All cattle	Number	9,496	9,922
	Value	$ 317,775	$ 514,331

PLATES XXXVII AND XXXVIII.—Panoramic views showing Timber Preservation Plant of Baltimore and Ohio Railroad at Green Spring.

Beef cattle	Number	7,794	5,641
	Value $	242,168	$ 268,130
Dairy cows	Number	1,702	4,281
	Value $	75,607	$ 246,201
Sheep	Number	11,106	10,342
	Value $	105,764	$ 101,229
Goats	Number	156	138
	Value $	842	$ 706
Swine	Number	4,250	6,997
	Value $	35,116	$ 81,467
Domestic animals not on farms and ranges:			
Horses	Number (1)	--------	93
Mules	Number (1)	--------	15
All cattle	Number (1)	--------	171
Dairy cows	Number (1)	--------	125
Swine	Number (1)	--------	284
Chickens	Number (1)	104,156	93,695
	Value $	93,740	$ 83,524
Other poultry	Number (2)	--------	2,678
All poultry	Value (2)	--------	$ 88,945
Bees	Number of hives (1)	--------	1,871
	Value (1)	--------	$ 6,391
		1924.	1919.
Value of dairy products	$	78,916	$ 98,566
Value of chicken eggs produced and chickens raised:			
As reported	$	245,868	$ 270,056
Including estimates	(3)	253,839	--------
Value of honey and wax	(1)	--------	$ 8,947
Pounds of wool produced:			
As reported		41,537	43,143
Including estimates	(3)	45,424	--------
Value of wool:			
As reported	$	16,615	$ 25,936
Including estimates	(3) $	18,170	--------
Crops:			
Corn	Acres	8,312	11,991
	Bushels	96,741	309,010
Oats	Acres	2,853	3,451
	Bushels	54,288	68,002
Wheat	Acres	6,120	8,650
	Bushels	63,075	96,743
Barley	Acres	21	92
	Bushels	159	1,035
Rye	Acres	2,211	4.842
	Bushels	18,237	42,774
Buckwheat	Acres	6,356	3,784
	Bushels	39,741	55,584
Total hay acreage		12,173	12,209
Total production of all hay (tons)		14.353	12,383
Timothy alone	Acres	2,825	2.250
	Tons (1)	--------	2,242
Clover	Acres	42	265
	Tons (1)	--------	326
Alfalfa	Acres	250	141
	Tons (1)	--------	368

White potatoes	Acres	658	952
	Bushels	41,949	71,721
Sweet potatoes	Acres	4	52
	Bushels	133	2,878
Tobacco	Acres	5	--------
	Pounds	306	--------
Fruits:			
Apples	Bushels	556,985	287,275
Pears	Bushels (1)	--------	1,343
Peaches	Bushels	53,102	178,424
Small Fruits and Grapes:			
Plums and prunes	Bushels (1)	--------	880
Cherries	Bushels (1)	--------	1,054
Strawberries	Acres	3	6
	Quarts (1)	--------	5,530
Raspberries	Acres (1)	--------	16
	Quarts (1)	--------	10,226
Blackberries and dewberries	Acres (1)	--------	2
	Quarts (1)	--------	1,263
Grapes	Pounds (1)	--------	28,696

(1) Not collected for the 1925 Census.

(2) Tabulation deferred until a later date.

(3) For incomplete reports.

(4) Includes the value of 101 pounds of cheese made on farms; data for cheese not secured for 1924.

Value of Property in Hampshire County, by Districts*.

Real Estate Values.

Year	Sherman	Capon	Springfield	Romney	Mill Creek	Gore	Bloomery	Total
1923	$637,590	$502,790	$ 645,760	$1,024,510	$194,155	$ 703,290	$416,440	$4,125,035
1924	625,990	469,470	647.890	1,020,450	192,735	691,790	394,330	4,069,655
1925	622,960	490,040	650.395	1,027,540	194,695	689,930	394,770	4,070,330
Personal Property.								
1923	355,145	176,589	319.925	755,015	112,480	291,385	140.235	2,150,774
1924	332,430	153,605	304.500	681,527	106,030	273,520	118.680	1,970,292
1925	343,045	172,305	332.440	724,141	107,485	303.540	136.630	2,119,588
Public Utilities.								
1923	1,734	57,356	1,524,015	336,523	383	1,213.182	13,869	3,147,067
1924	1,600	56,856	1,530,672	339,734	300	1,216,573	14,626	3,160,361
1925	1,700	69,534	1,551,246	355,855	300	1,230,409	14,000	3,223,044

Total Valuation of Property in Hampshire County: 1923, $9,422,876; 1924, $9,209,308; 1925, $9,412,960.

*From records at the Auditor's Office, Charleston, West Va., John C. Bond, State Auditor. See also West Virginia Legislative Handbook and Manual and Official Register, 1924, pages 965-966 for totals for 1923 and 1924.

CLIMATOLOGICAL DATA.*

Romney, Elevation 824 feet.

Precipitation.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1891	----	----	----	----	----	----	----	----	----	----	2.22	2.09	----
1892	1.68	1.87	----	3.84	----	4.25	----	----	----	----	1.30	----	----
1897	1.37	6.03	1.79	1.70	4.66	2.45	3.68	2.06	2.35	0.90	4.56	2.49	34.04
1898	3.42	1.09	4.13	2.53	4.51	0.97	2.66	6.68	1.36	5.69	2.07	2.69	37.80
1899	2.12	3.34	3.35	1.08	7.32	3.81	2.59	0.34	3.61	1.66	1.70	1.54	32.46
1900	1.47	2.31	3.66	1.26	1.08	4.84	3.79	1.07	3.24	1.94	3.65	1.77	30.08
1901	1.81	0.11	2.51	6.21	6.34	1.64	2.45	6.76	2.10	0.15	2.95	5.65	38.68
1902	2.65	4.12	4.24	2.70	2.62	3.89	1.98	2.51	1.40	3.47	3.41	3.87	36.86
1903	3.08	3.49	3.27	3.74	3.86	4.65	5.68	4.01	2.00	3.23	0.92	0.40	38.33
1904	1.90	0.52	2.20	1.65	2.38	4.13	4.00	2.20	2.58	1.59	0.55	2.72	26.42
1905	2.03	1.00	2.97	1.35	3.66	4.59	7.20	4.75	1.23	3.35	1.18	1.93	35.24
1906	2.55	1.16	4.19	1.75	1.28	5.49	4.10	7.64	1.91	2.41	0.97	3.34	36.79
1907	4.34	1.51	2.53	1.42	3.71	4.09	2.38	3.22	6.33	1.20	2.37	2.33	35.43
1908	4.51	2.87	3.44	2.07	7.28	2.06	5.62	3.12	0.69	1.07	0.90	1.09	34.72
1909	2.31	2.49	1.54	4.81	2.91	6.98	1.05	2.67	2.33	3.04	0.56	1.86	32.55
1910	4.14	2.04	0.65	3.33	2.75	8.14	1.47	1.51	2.71	1.33	1.85	1.88	31.80
1911	5.19	1.22	2.96	3.25	0.87	4.99	2.59	9.12	3.59	3.49	2.19	3.43	42.89
1912	1.14	2.86	5.54	1.37	3.35	----	----	--		---	----	----	----
1914	----	----	----	----	----	----	6.09	3.13	1.80	----	----	----	----
1915	4.04	2.29	0.60	2.15	4.31	2.96	3.32	5.58	4.29	3.94	1.67	3.44	38.59
1916	2.08	2.80	6.02	4.01	3.01	3.87	2.70	2.66	3.15	2.20	1.69	1.87	36.06

*From the reports of the Weather Bureau. U. S. Department of Agriculture. The local observer at Romney is now Mr. Richard A. Bergdall, who followed Mr. George E. Arnold.

Precipitation (Continued).

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1917	3.16	2.44	4.05	3.53	3.20	3.52	3.07	4.90	2.79	3.38	0.55	1.30	35.89
1918	3.30	1.79	2.54	9.14	2.77	4.19	3.48	3.51	3.88	2.44	1.17	4.71	42.92
1919	1.77	1.40	3.68	2.00	5.02	4.07	5.03	3.73	1.91	4.30	3.13	2.63	38.67
1920	2.62	3.02	2.35	4.65	2.92	5.08	2.91	5.86	3.25	1.68	3.85	1.56	39.75
1921	1.04	1.38	1.30	1.05	5.77	4.68	8.90	4.34	6.25	1.21	2.52	1.89	40.33
1922	2.97	1.97	3.95	1.88	3.66	3.23	2.67	1.87	1.03	1.55	0.45	0.00	25.23
1923	0.00	0.00	1.66	3.23	1.32	2.91	3.14	4.40	2.82	1.20	1.39	2.87	24.94
1924	2.87	2.23	5.37	2.71	2.51	3.56	3.80	.75	0.00	.76	.70	1.08	26.34
1925	1.79	1.58	1.00	1.55	0.35	2.06	2.08	.90	1.39	4.52	1.57	1.15	19.94
1926	2.98	1.08	1.48	1.78	1.28	2.26	----	----	----	----	----	----	----
Means	2.68	2.18	3.02	2.86	3.87	3.89	3.65	3.79	2.69	2.37	1.92	2.47	35.39

Snowfall.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1897	5.0	13.0	3.0	----	----	----	----	----	----	----	----	----	
1898	----	----	----	----	----	----	----	----	----	----	----	3.0	----
1899	6.5	27.0	0.5	----	----	----	----	----	----	----	----	----	----
1900	----	6.0	13.5	----	----	----	----	----	----	----	0.	1.8	----
1901	1.0	T	----	----	----	----	----	----	----	T	T	1.5	2.5
1902	8.0	6.0	22.0	----	----	----	----	----	----	T	T	11.0	47.0
1903	6.0	14.0	2.0	----	----	----	----	----	----	----	1.0	1.0	24.0
1904	9.0	1.5	1.5	1.0	----	----	----	----	----	----	T	10.0	23.0
1905	11.8	1.5	3.5	1.3	----	----	----	----	----	T	T	7.0	25.1
1906	5.0	8.0	13.5	T	T	----	----	----	----	T	0	1.5	28.0
1907	6.0	15.0	4.5	----	----	----	----	----	----	----	3.0	0.2	34.7
1908	18.0	16.2	T	----	----	----	----	----	----	----	9.0	6.0	49.2
1909	10.5	7.0	2.0	0.5	----	----	----	----	----	----	T	1.5	21.5
1910	23.2	10.5	T	T	----	----	----	----	----	T	T	11.0	44.7
1911	5.0	9.0	8.0	2.0	----	----	----	----	----	----	T	T	24.0

Snowfall (Continued)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1912	----	3.0	1.5	----	----	----	----	----	----	----	----	----	----
1913	----	----	----	----	----	----	----	----	----	----	----	----	----
1914	----	----	----	----	----	----	----	----	----	----	----	----	----
1915	2.0	----	4.0	----	----	----	----	----	----	----	T	3.0	----
1916	5.0	12.0	5.0	7.0	----	----	----	----	----	----	----	8.0	37.0
1917	6.0	15.0	34.0	----	----	----	----	----	----	6.0	1.0	13.0	75.0
1918	33.0	1.0	29.0	----	----	----	----	----	----	----	----	1.0	64.0
1919	8.0	2.0	T	T	----	----	----	----	----	----	----	4.0	14.0
1920	4.0	16.0	T	1.0	----	----	----	----	----	----	3.0	1.0	25.0
1921	1.0	11.0	0	T	----	----	----	----	----	----	----	4.0	16.0
1922	19.0	8.0	----	----	----	----	----	----	----	----	T	----	----
1923	----	4.8	7.5	0	T	----	----	----	----	T	T	T	----
1924	3.0	8.0	25.0	6.5	----	----	----	----	----	----	----	----	----
1925	----	----	T	0	----	----	----	----	----	----	0	----	----
Means	8.9	9.0	6.9	0.7	T	----	----	----	----	0.3	0.7	4.5	31.0
Aver.	9.1	9.4	7.0	0.6	T	0	0	0	0	0.3	0.9	4.8	32.1

T=Trace.

Temperature.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1897	29.6	30.2	45.5	52.4	61.0	70.8	76.7	70.1	66.1	56.9	44.0	35.8	55.8
1898	35.5	32.8	48.1	48.8	64.0	71.4	75.8	74.2	65.0	55.7	41.1	33.2	53.8
1899	31.2	29.4	40.7	53.2	64.2	72.4	74.8	73.9	64.5	56.3	44.2	33.2	52.8
1900	34.6	30.0	37.4	52.8	63.5	71.4	76.4	77.0	73.6	59.2	47.2	33.8	54.7
1901	33.2	29.1	42.4	48.6	62.2	71.0	77.6	74.8	65.6	54.1	38.1	31.4	52.3
1902	29.8	26.0	43.1	50.3	64.4	69.2	75.8	70.4	65.6	55.4	49.0	33.2	52.7
1903	29.8	34.6	49.3	52.1	63.6	64.8	74.2	70.4	62.5	56.0	38.8	26.9	51.9
1904	22.5	26.7	42.0	46.9	62.4	70.4	----	----	66.8	52.7	40.6	31.2	----
1905	26.5	----	43.0	48.8	64.6	70.6	73.0	71.5	64.0	56.3	42.7	----	----
1906	38.8	34.6	38.6	56.0	66.4	73.0	75.4	78.4	71.8	53.7	44.0	33.6	55.4
1907	34.6	27.8	47.8	46.4	59.7	65.8	75.4	70.4	66.2	48.0	40.2	32.8	51.3
1908	28.6	27.2	45.5	54.1	62.4	69.6	75.2	70.5	64.8	53.8	41.5	34.8	52.3
1909	31.6	39.8	37.9	51.4	61.3	71.8	72.4	70.5	63.8	49.6	46.8	27.8	52.1
1910	30.0	30.1	49.2	53.8	60.0	67.2	75.6	71.6	68.0	57.2	38.2	26.5	52.3
1911	34.0	34.4	37.9	47.8	67.4	71.2	75.8	74.4	68.0	54.4	39.5	37.5	53.5
1912	20.7	26.0	38.2	53.2	----	----	----	----	----	----	----	----	----
1913	----	----	----	----	----	----	----	----	----	----	----	----	----
1914	----	----	39.2	----	----	----	72.8	71.8	----	----	----	----	----
1915	32.2	37.8	37.7	57.6	61.7	69.4	75.4	73.0	69.4	57.7	45.6	33.0	54.2
1916	38.9	33.2	37.0	53.7	66.6	66.9	75.9	74.7	64.8	53.8	44.4	33.8	53.6
1917	34.3	33.3	41.5	47.6	55.8	70.4	75.2	73.0	62.0	51.1	41.8	24.2	50.8
1918	19.2	36.3	47.3	52.4	69.4	69.4	72.1	77.1	63.4	58.8	42.0	40.4	53.1
1919	36.4	37.4	45.1	54.6	62.4	73.0	75.4	72.2	67.3	62.8	44.6	30.0	55.1
1920	27.0	31.2	45.0	51.8	59.3	69.2	71.4	71.2	64.0	56.0	42.0	35.8	52.0
1921	36.6	39.6	52.8	59.4	62.3	72.6	76.7	69.6	71.7	55.2	46.4	39.0	56.8
1922	27.0	38.0	44.6	54.2	64.6	71.0	73.2	69.4	67.2	57.2	47.4	----	----
1923	----	----	43.0	51,0	60.6	72.4	72.4	71.3	67.0	53.5	42.4	41.5	----
1924	29.5	31.0	39.4	50.8	57.8	70.8	73.2	----	----	54.9	43.0	35.3	----
1925	29.2	39.6	42.8	54.3	60.2	----	74.4	----	71.5	48.6	40.0	----	----
Means	30.8	33.0	42.9	52.0	62.6	70.2	74.7	72.6	66.6	55.0	42.9	33.2	52.9

Average number of days with 0.01 inch or more of precipitation.

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
8	7	8	8	10	10	8	8	6	6	6	7	92

Mean Temperature.

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
30.9	32.2	42.6	51.6	63.0	69.9	74.9	72.9	66.1	55.2	42.7	32.4	52.9

Mean Maximum Temperature.

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
40.5	42.5	53.3	63.8	76.0	83.1	88.1	86.3	79.4	68.7	54.0	41.6	64.8

Mean Minimum Temperature.

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
21.0	22.3	31.2	38.8	49.6	56.5	61.7	59.7	52.3	41.7	31.3	22.4	(40.7)

Highest Temperature.

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
77	74	94	101	98	100	102	109	100	93	83	72	109

Lowest Temperature.

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
–20	–11	4	16	28	37	43	42	31	20	6	–15	–20

Prevailing Wind Direction.

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
W.	W.	W.	W.	W.	W.	W.	W.	W.	W.	W.	W.	W.

Frost Data.

Average date of last killing frost.	Average date of first killing frost.	Latest date of killing frost in spring.	Earliest date of killing frost in autumn.
April 29	October 6	May 21	Sept. 11

PART II.

Hardy County.

CHAPTER VI.

HISTORICAL AND INDUSTRIAL DEVELOPMENT.

LOCATION.

Hardy County is situated in the northeastern part of the State and lies directly south of Hampshire County, being included between the parallels of 38° 46′ and 39° 14′ North Latitude, and the meridians of 78°30′ and 79°08′ West Longitude from Greenwich. Its greatest width from east to west is 31 miles and from north to south is 34 miles.

Hardy County is bounded on the north by Hampshire County, on the east by Shenandoah County, Virginia, and on the south by Rockingham County, Virginia, and Pendleton County, West Virginia, and on the west by Grant County. The entire area of the county is drained by the waters of the Potomac River, carried to the Atlantic through Chesapeake Bay. The principal streams are the South Branch of the Potomac River, which forks at Moorefield to form the Moorefield River, Little Cacapon River and Lost River. Lost River sinks into the earth about four miles southwest of Wardensville and after its emergence, 2.3 miles farther down, is called Cacapon River.

The geographical position of Hardy County is to be seen on Figure 2 in the Author's Preface.

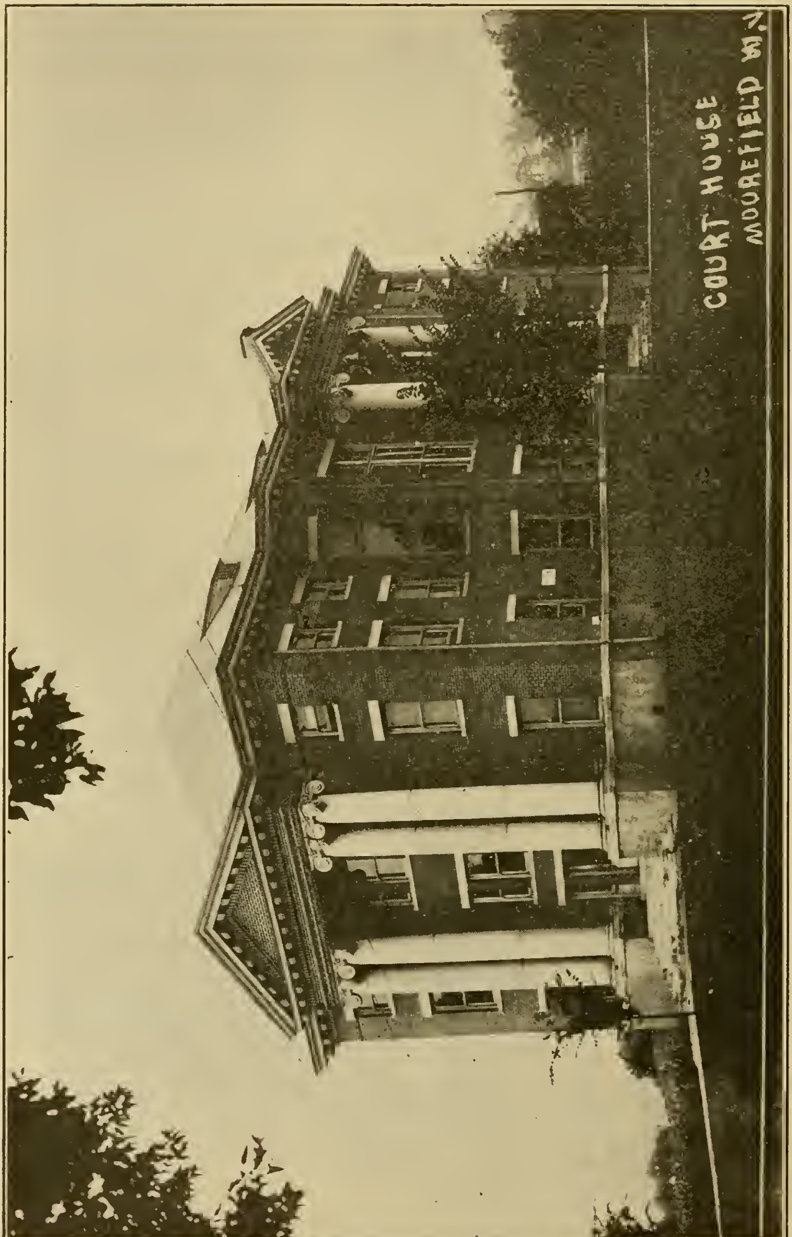

PLATE XXXIX.—View of Court-House at Moorefield.

TRANSPORTATION.

Waterways.

At the present time water transportation is not made use of in Hardy County. In previous years before the advent of the railroads some of the larger streams were made use of in floating rafts. In the early iron industry of both Hampshire and Hardy Counties the iron was carried nearer the markets by means of rafts and flatboats during the high waters of the rainy seasons. To dam the waters on any of the main streams a sufficient height for transportation would flood the best farming lands of the region, and since farming is the principal occupation of the people it is doubtful if this will come about.

Railroads.

In Hardy County there are two standard-gauge railroads, the Baltimore and Ohio and the Winchester and Western. The Baltimore and Ohio which is known as the Petersburg (South) Branch, connects with the main line at Greenspring, Hampshire County and terminates at Petersburg, Grant County, with a total mileage of 51.6. Hampshire has 29 miles; Hardy 19.5 miles, with the remaining 3.1 miles in Grant County.

The Winchester and Western which runs from Winchester, Virginia, to Wardensville, Hardy County, has only four and one-half miles of track within the county limits. Even though the mileage is small the road is a great help to the people of the eastern part of the county.

Various lumber companies have considerable mileage of narrow-gauge railway, but this is used almost exclusively for hauling lumber and is of little use to the people of the county.

Highways.

State Routes.—Up until the last few years Hardy County was without any improved highways. Under the new State Road building plan, however, Hardy will soon have completed two State routes, one passing from north to south from Romney, Hampshire County, via Moorefield to Petersburg, Grant County, the other from east to west, starting at the State line on the Winchester road passing through Wardensville and continuing west to Moorefield.

The Northwestern Turnpike.—(State Route No. 1).—The following description of the Northwestern Turnpike is taken from Dr. J. M. Callahan's Semi-Centennial History of West Virginia, pages 106-9, published in 1913:

"The old Northwestern Turnpike, extending from Winchester, Virginia, on a general westward course to Parkersburg on the Ohio, is a historic highway which deserves more mention than it has ever received as a factor related to the American westward movement and to the problem of communication between East and West. It was the inevitable result of the call of the West and the need of a Virginia state road.

"Perhaps its first suggestion was recorded by Washington, who in 1758 had been the champion of the Braddock road (not then supposed to lie in Pennsylvania) and who in 1784 sought a route located wholly in Virginia. Returning from a visit to his western lands, after following McCulloch's path (then the most important route across the rugged ridges between the valleys), he crossed the North Branch on the future route of the greater Virginia highway—which was partially realized in the 'state road' authorized from Winchester via Romney to Morgantown before 1786, and extended westward in 1786 by a branch road from near Cheat to Clarksburg, from which the first road was marked to the mouth of the Little Kanawha between 1788 and 1790.

"The later turnpike was planned and constructed by Virginia partly as a result of the rival activities of New York, Pennsylvania, and Maryland to secure the advantage in transportation facilities for the trade of the West; and was especially regarded as a rival of the National road which was opened from Cumberland to Wheeling in 1818, and with which parts of Virginia obtained better connection in 1830 by a stage line established from Winchester to Cumberland. It was built across the Appalachian divide with the hope of securing commercial superiority, and was the main thoroughfare between East and West through northern Virginia.

"The act in incorporation of 1827, authorizing subscriptions at Winchester, Romney, Moorefield, Beverly, Kingwood, Pruntytown, Clarksburg and Parkersburg, made the mistake of arbitrarily locating the route through important towns without proper consideration of the physical features of the country. After finding a way through Hampshire via Mill Creek Gap in Mill Creek Mountain, and pushing on into Preston, the engineers encountered insurmountable obstacles to the Kingwood route, causing the stock to languish.

"The enterprise was saved by the remarkable act of 1831 which organized a road company, with the Governor as President and one of the Board of Directors, with power to borrow money ($125,000) on the credit of the State to construct a turnpike road of a minimum width of twelve feet, 'from Winchester to some point on the Ohio River to be situated by the principal engineer', and with the right to erect bridges or to regulate ferries already in existence and to establish toll-gates on each twenty-mile section completed.

"The chief engineer was Col. Claudius Crozet, a French officer of artillery under Napoleon Bonaparte in the Russian campaign, and later professor of engineering in the United States Military Academy from 1816 to 1823. He was assisted by Charles B. Shaw.

'The chosen route was through Hampshire, Mineral, Grant, Garrett, Preston, Taylor, Harrison, Doddridge, Ritchie, and Wood—all in West Virginia except Garrett which is in Maryland. In Hampshire

County it was established via Capon Bridge, Hanging Rock, Pleasant Dale, and Augusta to Romney, west of which it crossed the South Branch. Through Mineral it passed via Burlington, thence westward across Patterson Creek, and through Ridgeville on the divide to New Creek which it crossed at Rees' tannery. Then turning toward the southwest, it crossed the North Branch of the Potomac southwest of the present town of Gormania and entered the southwest corner of Maryland through which it passed for eight and three-fourths miles, crossing the Alleghenies and emerging into Preston east of the German settlement (later known as Aurora). It passed across the picturesque Cheat Valley considerably south of Rowlesburg, and via Fellowsville, Evansville, Thornton, Grafton, Pruntytown, and Bridgeport to Clarksburg, thence over the summit via the head of Ten Mile Creek to Salem, thence across Middle Island Creek at West Union and via Tollgate, Pennsboro, Ellenboro (earlier Shumley), the head of Goose Creek, and Murphytown, to Parkersburg. Much of the route passed through a vast wilderness interspersed here and there by a few old settlements and towns.

"'No longer dependent on the larger towns for its success, the road was completed through the wilds of Preston, considerably south of Kingwood, in 1882, and was opened westward to Clarksburg and Parkersburg by 1838. Its construction cost $400,000. It crossed the mountains by easy grades and the larger streams (in some sections all the streams) by good bridges. It was macadamized from Tygart Valley River to Parkersburg in 1848. About 1852, it was further improved by construction of new bridges across several streams at important crossings. In 1840, facilities for travel and news were increased on the western end of the road by the establishment of a daily line of stages, and a regular mail service, which made connection with the Ohio steamers at Parkersburg. By 1845, there was a line of fast tri-weekly stages at Romney to the Ohio at Parkersburg. It connected at Romney with stages from Winchester, from Moorefield, and from Green Spring at which connections were made with Baltimore by trains of the B. & O. Railway. The fare from Green Spring to Parkersburg (210 miles) was $10.00.

"The road, establishing commercial and other relations, soon became a busy thoroughfare of travel and traffic which stimulated the creation of many inns and towns along the route—such as Aurora, Fellowsville, Evansville (1833), and West Union (1846). In many ways it influenced the material prosperity and social life of the people of the region through which it passed. Following the act of 1831, which provided for satisfactory adjustment of land titles, it was an important incentive to immigration and settlement and development —especially along the region of southern Preston and in Ritchie. Its construction also stimulated the construction of intersecting roads, such as the Brandonville pike, starting from Somerfield, Pennsylvania, passing via Kingwood, and connecting with the Northwestern at a point which became Fellowsville by 1848. It also doubtless influenced the legislature in 1837 to provide for a survey of Cheat from the turnpike crossing to the Pennsylvania line. On some parts of the course it furnished the incentive for the establishment of inns to meet the needs of those who desired to escape the heat of the seaboard by a summer sojourn amid the wild beauty of the mountains, whose streams were filled with trout and whose forest furnished a home for deer and other game.

"Beyond the headwaters of the Potomac, it passed over the Backbone, opening the way to a remote and inaccessible region bordering on the land of Canaan, which was made famous a few years later by 'The Clerk of Oxenford' (David Hunter Strother) in 'The Blackwater Chronicle' and later by the same writer under the nom de plume 'Porte Crayon' in 'A Visit to the Virginian Canaan.'

"It might have been a road of greater importance if Virginia soon after its completion had not been induced to divert her interest from turnpikes to canals—influenced by the completion of a Pennsylvania system of transportation connecting with the Ohio at Pittsburgh. West of the Alleghenies, it was extensively damaged by the numerous heavy cattle driven over it in the winter and early spring. It was also much injured by high waters, especially in 1852 and 1853.

"Although it never became of national importance as did its more renowned national rival at the north, it was for awhile the busy scene of much business of a national character and gave fair promise of serving well the purpose for which Virginia had planned it until its larger usefulness was transferred to its horseless rival which, persistently overcoming obstacles and opposition, reached Cumberland by 1845, Grafton in 1852, and Parkersburg in 1857.

"Supported by a sentiment that long scorned the possibility of competition and that later opposed any improved system of transportation which, by absorbing the slower traffic, might close the taverns and ruin the local market for grain and provisions, it was finally paralleled by a railroad which diverted its travel and traffic, created rival towns, and brought pioneer prospectors and promoters who prepared the way for the later era of larger industrial development.

"Although its utility was diminished by proximity to the railroad, it was still in moderate repair in the decade after the close of the war, and it has continued a constant local benefit to the territory through which it passes."

While the Northwestern Turnpike does not cross Hardy County, it has affected the transportation to a large extent from the Moorefield and Petersburg regions to the north, and with the completion of State Route No. 28 to Junction will be the main outlet, both eastward and westward, for all the region from Moorefield southward, or until such time as State Route No. 54 is paved from Romney to Alaska from which point a hard-surfaced road extends to Cumberland where connection is made with the National road.

The Northwestern Turnpike (State Route No. 1) crosses Hampshire County in an east and west direction, but only a short reference to the Turnpike is made on page 4 of this report and for that reason Dr. Callahan's article is incorporated in the Hardy portion of the volume since it is now too late to insert the matter elsewhere since that portion of the book has been printed.

It is interesting to note Dr. Callahan's statement that the original cost of the Northwestern Turnpike was $400,000 and compare that figure with the $853,477.66 which the State Road Commission has authorized to be expended on this route in Hampshire County alone, up to June 30, 1926, and the total sum of $5,140,283.42 authorized to be spent on this route throughout its length to the date mentioned.

The early completion of the paving of the Northwestern Pike its entire length from Parkersburg to Winchester will once again result in a continuous movement of tourists and other traffic and put on display some of Nature's most gorgeous scenery, and add much to the general prosperity of the counties traversed and those having direct connection by paved roads.

County Roads.—Hardy County is well supplied with dirt roads, many of which can be traveled the year round by automobile. The road paralleling Lost River is an exceptionally good dirt road in the dry months of the year. This is due to the material on which it is built since it follows an outcrop of the Hamilton-Marcellus Shales. If this road is kept properly drained it will give excellent service the greater part of the year. The dirt roads from east to west are usually passable the year round though somewhat rough. These roads are usually sandy because of the large number of sandstones and sandy shales that are crossed.

After the Hampshire County portion of this volume had been printed, the State Road Commission issued its annual report for 1925-1926, and for that reason the data on roads in Hampshire County contained in the report mentioned could not be inserted at their proper place and are therefore incorporated with those for Hardy County at this point.

The following data concerning the roads of Hampshire County are taken from pages 69-71 of the Annual Report of the State Road Commission of West Virginia for 1925-1926:

County-District Road Work.

Under construction at end of fiscal year: None.
Completed during fiscal year:
- Grassy Lick—3 miles shale.
- Springfield Pike—1.5 miles shale.
- Springfield Pike—2.0 miles shale.
- Green Spring—3.0 miles shale.
- Glebe Road—2.0 miles shale.
- Timber Ridge—3.0 miles shale.

Completed prior to fiscal year: None.

County Financial Data.

Bonds voted during fiscal year: None.

County road levy	$22,997.87
District road levies:	
Mill Creek District	$ 448.60
Romney District	1,495.96
Sherman District	1,438.81
Bloomery District	733.58
Capon District	991.90
Gore District	3,272.52
Springfield District	3,724.52

State Road Work Done by State.

Under construction at end of fiscal year:

Project 135A—Hanging Rock-Capon Bridge—5.63 miles bituminous macadam.

Project 135—Capon Bridge-Virginia Line—5.2 miles bituminous macadam.

Project 3223—Great Cacapon-Paw Paw—1.47 miles grading.

Completed during fiscal year:

Project 134—Hanging Rock Bridge No. 670 superstructure.

Project 134—Pleasantdale-Hanging Rock—3.9 miles shale.

Project 3011A—Mechanicsburg Gap-Romney—3.58 miles bituminous macadam.

State Road Work Done by County.

None.

State Funds Apportioned.

State Bonds	$855,616.00
Federal Aid	25,097.55
Total	$880,713.55
Authorized for construction	$980,670.64

Under State Maintenance.

Project 72—Northwestern Turnpike—6.60 miles waterbound macadam.

Project 72S—Northwestern Turnpike—0.59 mile waterbound macadam.

Project 3011A—Mechanicsburg Gap—3.58 miles bituminous macadam.

Project 3011—Bridge No. 803.

Project 3012—Junction-Hardy Line—8.63 miles graded.

Project 3011B—Mechanicsburg Gap-Mineral Line—5.0 miles waterbound macadam.

Project 3147A—Frenchburg-Pleasantdale—5.09 miles graded.

Project 3011B—Mill Creek Bridge No. 802.

Project 134—Bridge No. 670.

Project 134—Pleasantdale-Hanging Rock—3.9 miles shale.

On State Route not taken over: None.

Additional State Route Designated.

Beginning at McDonald's near the Hampshire-Morgan Line; thence to the Morgan County Line near Woodrow.

The following data concerning the roads of Hardy County are taken from page 75 of the Annual Report of the State Road Commission of West Virginia for 1925-1926:

County-District Road Work.

Under construction at end of fiscal year: None.
Completed during fiscal year: None.
Completed prior to fiscal year: None.

County Financial Data.

Bonds voted during fiscal year: None.
County road levy ---------------------------------------$12,500.00

State Road Work Done by State.

Under construction at end of fiscal year:

Project 3214A—Moorefield-Baker—4.77 miles shale and 0.29 mile bituminous macadam.

Project 62—Moorefield Bridge No. 739.

Project 3214B—Moorefield-Baker—4.82 miles shale.

Completed during fiscal year:

Project 3013—Oldfields-Hampshire Line—5.85 miles waterbound macadam.

State Road Work Done by County.

None.

State Funds Apportioned.

State Bonds ---$641,711.00
Federal Aid --- 18,823.17

Total ---$660,534.17
Authorized for construction -----------------------------$585,938.69

Under State Maintenance.

Project 1051—Moorefield-Wardensville—2.22 miles graded.

Project 62—Moorefield-Oldfields—6.8 miles bituminous treated gravel.

Project 62—Moorefield-Oldfields—0.8 mile rock asphalt.

Project 3013—Mudlick Run Bridge No. 808.

Project 3148—Petersburg Gap Bridge No. 875.

Project 3148—Grant County-Moorefield—8.69 miles gravel.

Project 3013—Oldfields-Hampshire Line—5.85 miles waterbound macadam.

On State Route not taken over: None.

The following data on State Aid Projects are taken from tables on pages 168-170 of the Annual Report of the State Road Commission of West Virginia for 1925-1926:

Data on State Aid Projects.

Project No.	Name of Road.	County	Type of Road.	Length in Miles.	Cost of Draining and Grading
1034	Northwestern Turnpike	Hampshire	Bridge	------	$15,000.00
1051*	Moorefield-Va. State line	Hardy	Earth	2.2	14,988.50
1053	Romney-Moorefield	Hampshire	Bridge	------	24,200.00
1077	Moorefield-Romney	Hardy	Maintenance	6.00	18,975.00
1106	Romney-Augusta	Hampshire	Bridge	------	9,000.00

(Table continued)

Project No.	Total Cost Per Mile.	State Aid.	Amount Aid Paid.	Per Cent. Complete
1034		$ 4,500.00	$ 4,500.00	100
1051*	$6,812.96	14,000.00	14,000.00	100
1053		13,925.00	13,925.00	100
1077	3,162.00	2,125.00	2,125.00	100
1106		4,500.00	4,500.00	100

*Indicates improved mileage on State Routes not duplicated elsewhere.

The following data on Federal Aid Projects are taken from tables on pages 172-177 of the Annual Report of the State Road Commission of West Virginia for 1925-1926:

Data on Federal Aid Projects.

Project No.	Name of Road.	County	Type of Road.	Length in Miles.
62	Old Fields-Moorefield	Hardy	Gravel	6.8
62 *	Moorefield Bridge	Hardy		
62 *	Moorefield Street	Hardy	Rock Asphalt	0.8
62 *		Hardy	Reconstruction and Plans	
72	Romney-Augusta	Hampshire	W. B. Macadam	7.10
72 *		Hampshire	Engr. Supervision	
134 *	Pleasantdale - Hanging Rock	Hampshire	Earth and Bridge	3.90
135A*	Hanging Rock-Capon Bridge	Hampshire	Bituminous Macadam	5.63
135B*	Capon Bridge-Virginia line	Hampshire	Bituminous Macadam	5.20

*Indicates improved mileage on State Routes not duplicated elsewhere.

(Table continued)

Project No.	Estimated Cost	Federal Aid	State Fund	Status
62 ---	$ 57,036.00	$ 28,518.00	----------	Complete
62* ---	15,862.83	----------	$ 16,481.49	81% Complete
62* ---	20,020.00	----------	19,269.60	Complete
62* ---	----------	----------	4,725.62	Complete
72 ---	104,500.00	52,250.00	----------	Complete
72* ---	----------	----------	2,000.00	----------
134* ---	116,300.00	49,857.35	49,857.36	Complete
135A*---	241,230.77	84,450.00	156,780.77	82% Complete
135B*---	199,551.44	99,775.72	99,775.72	54% Complete

The following data on State Projects are taken from tables on pages 179-192 of the Annual Report of the State Road Commission of West Virginia for 1925-1926:

Data on State Projects.

Project No.	Name of Road.	County	Type of Road.	Length in Miles.	Cost of Draining and Grading
72S	Romney-Augusta --	Hampshire	W. B. Macadam	-----	$ 5,195.59
3011A-B	Northwestern Turnpike -------------	Hampshire	Bituminous Macadam	8.58	71,092.19
3011A-B	Northwestern Turnpike -------------	Hampshire	Bridges	-----	--------
3012 ---	Junction-South ------	Hampshire	Earth	8.63	106,714.40
3013 ---	Old Fields-North ---	Hardy	Bridge 808	-----	--------
3013 ---	Old Fields-North ---	Hardy	W. B. Macadam	5.85	54,926.17
3147 ---	Frenchburg-Pleasantdale -------------	Hampshire	Earth	5.09	67,623.46
3148 ---	Moorefield-Grant Co.	Hardy	Bridge	-----	--------
3148 ---	Moorefield-Grant Co.	Hardy	Gravel	8.69	79,591.44
3173 ---	-------------------	Hampshire	Surveys and Plans	-----	--------
3214A--	Moorefield-Baker ---	Hardy	Shale and Bituminous Macadam	5.06	62,072.58
3214B--	Moorefield-Baker ---	Hardy	Shale	4.82	67,080.00
3216 ---	-------------------	Hampshire	Surveys and Plans	-----	--------
3223 ---	Near McDonald's -----	Hampshire	Earth	1.47	17,700.00
3257 ---	-------------------	Hampshire	Surveys and Plans	-----	--------
3258 ---	-------------------	Hampshire	Surveys and Plans	-----	--------

(Table continued)

Project No.	Cost of Paving	Total Cost Per Mile	Total Amount of Authorization	Cu. Yds. Excavation, Unclassified.	Price Per Yard	Status	
72-S	$ 6,851.63		$ 12,047.22	4,000	$1.00	100%	Complete
3011A-B	125,860.21	$ 22,954.82	196,952.40	47,307	0.63	100%	Complete
3011A-B			21,135.88			100%	Complete
3012		12,364.00	106,714.40	85,680	0.65	100%	Complete
3013			10,902.15			100%	Complete
3013	112,221.60	28,572.27	167,147.77	34,300	0.70	100%	Complete
3147		13,285.55	67,623.46	39,800	0.63	100%	Complete
3148			51,176.31			100%	Complete
3148	62,073.16	16,302.02	141,664.60	42,785	0.53	100%	Complete
3173			3,820.07				
3214A	21,690.10	16,553.88	83,762.68	55,000	0.55	83%	Complete
3214B	9,120.00	15,809.12	76,200.00	75,000	0.54	16%	Complete
3216			3,600.00				
3223		12,040.81	17,700.00	14,300	0.58	90%	Complete
3257			500.00				
3258			300.00				

Statement of County Apportionments, County Balances, Allotments Out of Reserve, and Authorizations.

	Hampshire County.	Hardy County.
County Apportionments:		
80% Bond	$855,616.00	$641,711.00
80% Federal Aid Receipts	25,097.55	18,823.17
80% County Total	$880,713 55	$660,534.17
80% County Balances		$ 74,595.48
Authorizations:		
80% County	$880,713.55	$585,938.69
Reserve Allotted to Jan. 31, 1925		
Reserve, Other	99,957.09	
Total Authorizations	$980,670.64	$585,938.69

Nature of Construction Fund Authorized Expenditure.

	Hampshire County.	Hardy County.
Survey, Plans, and Advert:		
Roads	$ 22,547.55	$ 16,921.07
Bridges	479.78	811.76
Reconstruction		
Construction:		
Grading and Draining	$366,916.61	$241,202.83
Paving	538,546.94	238,460.64
Bridges—Substructure	14,962.34	28,765.47
Bridges—Superstructure	25,078.62	40,009.93
Reconstruction	12,138.80	19,766.99
Total	$980,670.64	$585,938.69

Summary of Authorizations Issued, Arranged by Routes and Counties, to June 30, 1926.

Route 1—Hampshire County	$ 853,477.66
Route 9—Hampshire County	17,700.00
Route 23—Hardy County	160,262.63
Route 23—Hampshire County	----------
Route 28—Hampshire County	109,470.75
Route 28—Hardy County	425,676.01
Route 54—Hampshire County	22.23
Total	$1,566,609.33

The above statements relative to County Apportionments, and Nature of Construction Fund Authorized Expenditure are taken from Appendix 9, an insert between pages 202 and 203 of the Annual Report of the State Road Commission of West Virginia for 1925-1926.

The Summary of Authorizations Issued, as above compiled, is taken from Appendix 10, pages 204-207 of the Annual Report of the State Road Commission of West Virginia for 1925-1926.

No State Road Work has been done by either Hampshire or Hardy County up to June 30, 1926, and no bonds were voted by either county during the fiscal year ending at the date mentioned.

GENERAL DESCRIPTION OF HARDY COUNTY.

Miscellaneous Items.

Formation.—The county of Hardy was formed from a part of Hampshire by an Act of the Virginia Legislature in October, 1785, which declared

"That from and after the first day of February next, the county of Hampshire shall be divided into two distinct counties by a line beginning at the North Branch of the Potomac, opposite to the mouth of Savage River, and running then in a direct course so as to strike the upper end of the plantation known by the name of Myre's Mill, on New Creek; thence in a direct course to Lewis' Mill, on Patterson's Creek; thence in a direct course to the highest part of the mountain known by the name of High Knob; thence in a direct course to the gap of the Short Mountain, where the North River runs through the same; thence along the road leading to the upper end of Henry Fry's plantation on Capon, and along the said road to the top of North Mountain to the dividing line between the two counties of Shenandoah and Hampshire; and that all of the said county lying south of the said line shall be called and known by the name of Hardy; and the residue of said county shall retain the name of Hampshire."*

*Virgil A. Lewis, History of West Virginia.

Another section of the act provided that the first court for the new county should be held at the house of William Bullitt, and that the justices composing it should then select a site for the county-seat. The site selected was at Moorefield, a town that had been established upon the lands of Conrad Moore in 1777.

The above boundaries remained until 1866 when the county was divided to form the new county of Grant. On February 14, 1866, the West Virginia Legislature passed the following Act:

"Be it enacted by the Legislature of West Virginia:

"1. So much of the county of Hardy as is included within the following boundary lines, to-wit: Beginning at Fairfax stone, at the junction of the line between West Virginia and Maryland, corner to said county of Hardy, and with the said boundary line down the north branch of the Potomac to the Hampshire (now Mineral) and Hardy County line; then with the said line southeastward crossing Patterson's Creek mountain, and thence running the division line between the proposed new county and Hardy County, southward along the top of the mountain to the gap below the mouth of Luney's Creek, thence with a straight line to the top of Elkhorn Rock, thence along the top of the mountain range which divides the waters of south Mill Creek from those of the South Fork to the Hardy and Pendleton County line, thence, with the latter northwestward to the Hardy and Tucker County lines, and with the latter to the beginning, shall form one distinct and new county, which shall be called and known by the name of Grant County."

Hardy County was named in honor of SAMUEL HARDY who had long been a distinguished resident of Isle of Wight County, Virginia.

Area.—The area of Hardy County, as determined with planimeter, by Paul H. Price from the topographic quadrangles of the U. S. Geological Survey, is as follows:

District.	Square Miles.
Moorefield	148.68
Capon	110.15
South Fork	186.72
Lost River	129.97
Total	575.52

Relief.—The relief of Hardy County is very rugged, being made up of a series of mountain ranges. The only comparatively level land in the county is bottom lands along the South Branch of the Potomac and Moorefield Rivers. On the east is the great North Mountain, the crest of which forms the boundary line with Virginia. South Branch Mountain continues across the county, joining up with Shenandoah Mountain on the south. Elkhorn Mountain enters the county from the southwest and continues for eighteen miles, flattening out three miles south of Moorefield. The elevations in the county vary from 725 feet above sea-level on the South Branch of the Potomac River in the "Trough" at the Hampshire-Hardy County line to 3320 feet on South Branch Mountain four and one-half miles northeast of Helmick Rock, or very near the center of the county.

Climate.—The climate of Hardy County is much like that of the other counties of the Allegheny region. There being only one recording station in the county, located at Moorefield, the records taken there would not be true for the entire county. Because of the ruggedness of the area, there is distinctly a wide variance in temperature. The low valleys of the South Branch and Moorefield Rivers, also Lost and Cacapon Rivers, being hemmed in by the mountains, are protected from the more severe storms. At Moorefield the mean annual temperature is 53.5° F. The summers are pleasant, though in the valleys the temperature is often high, occasionally exceeding 100° F. The winters are moderately cold, the seasonal mean being 40.4° F. Cold spells do occur but are usually of short duration.

The mean annual rainfall is 32.8 inches, and this does not vary much from year to year. This record has been kept since 1896 and the greatest annual rainfall was in 1898 with 41.68 inches. A part of the precipitation is in the form of snow, the average depth amounting to 36.2 inches, or if reduced to rain is a little more than two inches.

The climate is healthful and in the summer season many tourists visit the county to camp along the clear waters of the mountain streams.

The following tables, giving the meteorological data for the area, were furnished by Mr. H. C. Howe, of the United States Weather Bureau, Parkersburg, W. Va. The records are being kept at the present time by Mr. M. S. Henkle, Moorefield, W. Va.:

Precipitation at Moorefield, W. Va.

(Elevation, 900 feet.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1891	....	....	....	....	....	....	....	....	....	....	....	1.55	....
1892	1.53	1.72	1.91	2.44	2.82	3.73	3.64	....	....	....	....	....	....
1894	....	....	....	....	....	4.36	....	....	....	....	....	....	....
1895	....	....	....	....	....	....	....	....	....	....	....	2.58	....
1896	1.34	2.32	3.27	1.26	2.55	3.41	6.09	2.80	6.43	0.45	2.86	0.60	33.38
1897	1.15	7.60	1.39	1.91	5.24	1.94	2.97	2.95	1.20	1.16	2.93	2.52	32.96
1898	3.91	1.05	4.14	2.37	5.63	1.81	3.25	8.07	1.10	5.31	2.30	2.74	41.68
1899	2.91	4.43	3.01	0.92	4.95	3.57	4.09	3.17	3.64	1.86	0.48	1.30	34.33
1900	1.49	3.28	1.91	1.42	1.63	4.77	3.05	1.73	1.87	1.81	*4.00	*1.80	28.76
1901	*1.70	0.37	1.94	5.85	7.83	3.25	2.82	6.86	1.46	0.25	2.05	4.97	39.35
1902	1.64	3.88	5.09	3.26	2.28	3.31	2.91	1.72	2.07	*3.00	2.18	4.80	36.14
1903	2.58	2.58	2.70	3.02	2.30	5.32	3.31	2.84	2.56	3.31	0.73	0.30	31.55
1904	1.39	1.03	1.38	3.40	3.01	8.29	5.17	2.15	1.77	0.68	0.95	2.70	31.92
1905	2.05	0.80	1.69	1.10	2.81	6.44	5.67	3.55	1.40	2.69	1.10	1.87	31.57
1906	2.70	1.00	4.30	3.05	1.50	5.06	1.50	4.98	3.80	2.71	1.00	3.10	34.70
1907	2.90	1.20	1.05	1.75	2.91	2.56	5.72	3.40	5.85	0.90	2.40	2.35	32.99
1908	4.30	5.35	2.37	2.05	7.58	1.35	3.50	3.15	1.04	1.21	0.90	1.11	33.91
1909	1.60	2.70	1.23	5.68	2.04	6.43	1.52	2.34	1.23	3.35	0.23	1.48	29.83
1910	4.79	2.05	0.63	4.81	2.51	9.86	0.54	0.84	2.28	1.15	0.82	1.59	31.87
1911	6.73	1.14	2.32	2.61	6.35	*4.52	*1.52	*6.10	5.58	5.33	1.27	2.51	45.98
1912	1.27	3.41	4.70	1.66	3.69	3.87	*5.62	*0.87	4.00	0.21	0.82	2.00	32.12
1913	1.84	0.26	4.53	2.56	*6.55	3.11	*3.65	0.98	*1.92	5.28	4.13	2.59	37.40
1914	3.13	2.70	1.90	4.41	1.11	2.30	*3.64	*3.60	1.55	1.50	0.70	3.44	29.98
1915	2.52	3.04	....	....	....	....	....	....	....	3.17	1.67	2.45	....
1916	2.73	2.01	4.00	3.41	1.83	5.37	2.56	1.46	3.15	1.32	0.82	1.56	30.22
1917	2.52	2.25	3.72	2.27	2.95	1.90	1.25	*3.60	1.31	3.46	0.22	1.30	26.75
1918	3.95	0.87	2.75	7.26	3.45	3.28	3.62	2.20	2.47	2.26	1.35	3.71	37.17
1919	1.65	1.14	2.41	1.85	3.49	3.30	3.45	1.93	1.41	3.01	1.44	1.94	27.11
1920	1.96	3.42	2.47	4.37	1.83	5.15	3.58	6.51	2.31	0.42	2.83	2.04	36.89
1921	0.45	1.72	1.14	1.18	4.95	2.41	3.77	....	4.74	0.72	3.09	2.37	....
1922	2.00	3.82	3.29	1.20	....	....	....	....	....	....	0.17	....	....
1923	....	....	2.04	2.64	0.61	2.71	2.65	2.24	2.71	0.98	2.23	1.98	....
1924	....	....	4.28	2.16	8.09	2.86	2.52	1.76	4.13	1.05	1.71	0.90	....
1925	4.44	0.46	2.45	2.83	1.10	1.69	4.53	1.45	1.04	3.39	1.35	....	....
Means	2.54	2.30	2.69	2.83	3.54	3.95	3.39	3.05	2.60	2.11	1.61	2.20	32.81

Snowfall, Monthly, at Moorefield, W. Va.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1896	0.2	0.8	19.9	......	......	......	......	......	......	T	0.2	1.2	22.3
1897	3.9	19.8	0.5	0	T	......	......	......	......	......	T	2.0	26.2
1898	0.5	0	0.5	0.5	......	......	......	......	......	......	5.0	8.2	14.7
1899	3.5	26.0	0.2	0	......	......	......	......	......	......	0	0.5	30.2
1900	......	12.0	13.0	0	......	......	......	......	......	......	......	2.5	......
1901	......	1.7	......	T	......	......	......	......	......	......	T	T	......
1902	8.0	4.5	22.0	17.5	......	......	......	......	......	......	T	7.5	59.5
1903	8.0	8.0	T	0	......	......	......	......	......	......	......	......	......
1904	11.5	6.2	3.5	4.0	......	......	......	......	......	......	T	11.0	36.2
1905	23.0	7.0	2.4	T	......	......	......	......	......	......	T	1.4	33.8
1906	4.5	7.5	22.0	T	T	......	......	......	......	......	T	3.0	37.0
1907	6.0	12.5	4.0	8.0	......	......	......	......	......	......	4.0	5.0	39.5
1908	24.0	51.0	T	......	......	......	......	......	......	......	9.0	8.8	92.8
1909	8.0	8.5	3.5	T	......	......	......	......	......	T	T	6.0	26.0
1910	20.0	10.0	5.0	......	......	......	......	......	......	T	T	14.0	49.0
1911	6.0	5.0	11.0	3.0	T	......	......	......	......	......	T	T	25.0
1912	11.0	3.5	3.0	......	......	......	......	......	......	......	T	9.0	26.5
1913	2.0	1.0	T	......	......	......	......	......	......	......	T	3.0	6.0
1914	18.5	27.0	19.0	......	......	......	......	......	......	......	T	9.0	73.5
1915	13.0	......	......	......	......	......	......	......	......	......	......	......	......
1916	......	14.0	1.9	......	......	......	......	......	......	......	......	8.0	......
1917	7.0	......	......	......	......	......	......	......	......	......	T	13.0	20.0
1918	30.5	1.5	0	30.0	......	......	......	......	......	......	......	0.1	62.1
1919	8.0	1.5	......	T	......	......	......	......	......	......	......	7.0	......
1920	4.0	18.5	T	T	......	......	......	......	......	......	......	T	22.5
1921	T	15.2	......	......	......	......	......	......	......	......	......	2.5	17.7
1922	19.5	20.5	T	......	......	......	......	......	......	......	0.2	......	......
1923	......	10.0	T	T	......	......	......	......	......	T	......	T	......
1924	......	......	8.0	T	......	......	......	......	......	......	3.5	......	......
1925	52.0	T	T	T	......	......	......	......	......	4.5	0	......	......
Means	11.7	10.9	5.6	2.1	T	......	......	......	......	0.2	0.8	4.9	36.2

Average Monthly Temperature, at Moorefield, W. Va.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1896	31.0	34.2	34.4	58.3	67.4	69.4	74.1	72.5	65.0	49.8	47.8	33.8	53.0
1897	27.6	34.8	45.6	52.2	58.7	68.2	73.2	69.8	65.5	55.6	42.0	35.8	52.4
1898	35.2	31.2	47.2	46.9	63.6	69.2	74.1	73.6	66.4	54.0	39.8	31.5	52.7
1899	29.8	23.0	40.8	51.2	62.8	70.7	73.4	72.8	62.2	55.0	42.6	31.0	51.3
1900	30.8	27.3	37.8	52.6	63.4	71.4	76.0	77.6	72.8	58.3	......	......	......
1901	......	31.6	44.8	49.2	63.0	70.3	76.2	74.2	65.1	55.1	41.6	34.6	......
1902	32.4	27.8	44.8	50.6	64.7	67.0	......	......	63.9	......	49.4	33.5	......
1903	31.1	34.2	49.2	51.6	63.5	64.7	72.2	72.1	62.4	52.2	36.7	29.6	51.7
1904	27.7	28.0	44.8	50.0	63.4	70.8	72.2	71.8	68.9	55.0	40.2	32.4	52.1
1905	30.0	25.2	47.0	53.8	66.2	71.3	74.6	72.6	68.1	56.6	42.8	36.0	53.7
1906	38.4	33.2	36.6	53.6	63.8	71.8	72.4	74.9	69.2	52.4	43.9	35.4	53.8
1907	36.8	30.6	49.6	46.2	59.5	64.5	72.0	70.4	66.0	49.6	42.7	35.2	51.9
1908	31.4	30.6	48.3	55.5	62.4	68.1	73.4	70.9	66.2	56.0	43.2	36.1	53.5
1909	36.2	42.3	40.6	53.0	......	71.1	71.2	70.9	64.4	49.6	50.5	28.0	......
1910	32.6	34.4	49.9	53.8	60.0	65.7	73.8	71.8	68.8	58.6	36.1	26.9	51.7
1911	34.0	36.0	37.8	46.2	65.0	......	......	......	70.5	57.8	43.6	38.4	......
1912	25.4	29.2	40.4	57.4	64.6	69.4	......	......	71.0	58.5	44.0	34.9	......
1913	38.8	34.6	47.4	......	......	70.9	......	74.6	......	53.7	50.6	37.4	......
1914	33.8	25.4	37.8	54.9	......	72.7	......	......	......	......	45.8	28.4	......
1915	30.2	33.9	......	......	......	......	......	......	......	......	......	......	......
1916	......	......	......	......	......	68.3	77.4	76.1	66.4	55.8	45.0	33.5	......
1917	35.7	35.4	43.2	54.2	59.4	70.8	76.7	......	63.6	51.5	41.4	23.8	......
1918	20.2	36.7	48.6	51.5	70.2	69.8	72.2	77.8	65.0	60.9	44.4	40.6	54.8
1919	36.3	37.6	46.6	54.4	64.3	74.4	76.8	73.4	66.8	64.0	45.8	31.0	56.0
1920	29.6	33.7	45.6	52.9	60.7	69.6	76.2	75.7	69.5	62.2	45.4	38.4	55.0
1921	40.2	42.8	58.0	61.0	63.2	73.8	77.6	72.6	73.0	57.4	......	38.4	......
1922	29.8	40.8	47.8	55.4	66.2	......	......	......	......	......	44.8	......	......
1923	......	......	......	......	......	......	......	71.6	67.6	53.2	43.8	43.8	......
1924	......	......	41.0	50.0	58.2	70.5	72.1	73.8	62.6	54.5	42.4	34.2	......
1925	29.2	40.2	46.4	55.0	59.0	73.0	73.5	71.0	72.2	50.8	42.0	......	......
Av.	32.1	33.2	44.5	52.7	63.0	69.9	74.2	73.2	67.0	55.3	43.6	33.8	53.5

Population.—The population of Hardy County as shown by the Bureau of the Census for 1920 is as follows:

	1920	1910	1900
Capon District, including Wardensville town	1,361	2,226	2,281
Lost River District	2,327	2,637	2,583
Moorefield District, including Moorefield town	3,186	3,545	1,763
South Fork District	2,727	1,955	1,822
Totals	9,601	9,163	8,449

From the above figures it can be seen that the county has had a steady growth in the last two Census years but the population seems to have been moving within the county. In Capon District, including Wardensville, the population has fallen from 2,281 in 1900 to 1,361 in 1920. Lost River District has fallen from 2,583 in 1900 to 2,327 in 1920. However, in the other two districts, Moorefield, including the town of Moorefield, has increased from 1,763 in 1900 to 3,186 in 1920, and South Fork has increased from 1,822 to 2,727 in the same period.

The reason for this movement is not known by the writer but since it was between the years of 1909 and 1911 that the Petersburg Branch of the Baltimore and Ohio Railroad was extended from Romney to Petersburg, it is reasonable to believe that this was the main reason for the movement of the population from the eastern part of the county to the western.

In 1920 the number of inhabitants per square mile in the county was 16.7. In the same year Moorefield, the county-seat, had a population of 630, while Wardensville had 745.

Postal Service.—Hardy County is served partly by railway mail service and partly by star routes. City or village delivery is not available in any of the towns of the county. The following table of the post-offices was taken from the U. S. Postal Guide. The figure after an office represents the number of rural routes emanating therefrom. The population and number of people served is also given. This information is an estimate furnished by the respective postmasters to an inquiry sent out by R. C. Tucker. Where no figures are given no reply was received.

P. O.	Population	No. Served
Baker	---	150
Bass	---	182
Brake	---	---
Doman	---	127
Durgon	---	---
Fabius	36	40
Fisher	25	100
Flats	5	138
Inkerman	---	---
Kessel	25	125
Lost City	250	500
Lost River	100	200
McCauley	10	125
McNeill	48	72
Mathias—1	100	700
Milam	---	250
Moorefield (ch)	---	1400
Needmore—1	31	530
Old Fields	100	300
Perry	90	105
Peru	20	50
Rig	100	150
Rockoak	---	204
Wardensville	---	1500

TOWNS AND INDUSTRIES.

Moorefield.

Moorefield, the county-seat of Hardy County, is located on the east side of the junction of the South Branch of the Potomac and Moorefield Rivers. It has been built upon the broad flood-plain of these two rivers with an approximate elevation of 820 feet above sea-level. The town was established by act of the Virginia Assembly in 1777, when Hardy was a part of Hampshire County, on the lands of Conrad Moore, from whom the town received its name.

Moorefield is one of the principal towns of the South Branch Valley and has long been one of the centers for social and educational activities. The High School is recognized by the West Virginia University as (conditioned) first class, with a principal, four teachers, and an enrollment of thirty-six students. It also has a Junior High School with three teachers and an enrollment of seventy-four students.

There are two banks, a national and a state. The South Branch Valley Bank began business in 1883, and now has a capital stock of $100,000. The Hardy County Bank began business in 1909 and now has a capital stock of $50,000.

The only newspaper published in the county is at Moorefield, the MOOREFIELD EXAMINER, published weekly by Sam A. McCoy. The paper was established in 1897 and has a circulation of 1,980.

PLATE XL.—Monument to Conrad Moore, founder of Moorefield.

The population of Moorefield for 1920 was 630.

South Fork Lumber Company.—According to H. S. Pownall, Manager, the South Fork Lumber Company, whose plant is in Moorefield, has 52,000 acres, mostly hardwoods, in Hardy, Grant, and Pendleton Counties. The greatest acreage is in Hardy with 45,000 acres, while 4,000 acres lies in Grant and 3,000 in Pendleton. The company employs 110 men and has a monthly pay-roll of approximately $8,000.

This company has approximately 20 miles of permanent narrow-gauge railway with an equal amount that is moved from place to plate. Plates LXVIII and LXVII, respectively, show panoramic views of this Company's yard at Moorefield and also its logging train.

Union Tanning Company.—The Union Tanning Company with headquarters in New York has one of its many plants at Moorefield. According to W. E. Loy, local superintendent, the plant employs forty-five men with an approximate monthly pay-roll of $5,000. This plant has a capacity of ninety-five hides daily. Both tan bark and tanning extract are used.

Wardensville.

Wardensville, the only other incorporated town in Hardy County, was established in 1832, in the northeastern part of the county on the waters of Cacapon River, just east of its forks with Trout Run. It is situated upon the first terrace of the Cacapon River, with an elevation near the center of the town of 1011 feet above sea-level. The town is entirely surrounded with high mountains, with the exception of the outlet to the northeast along the narrow valley of the Cacapon River. Wardensville is the second oldest town in the county, and was in former years a prosperous community. Since the discontinuance of the iron furnaces, however, the removal of most of the immediate timber, business enterprises are not so numerous. This is the only shipping point from the eastern part of the county. A standard-gauge railroad from Winchester, Virginia, (Winchester and Western) terminates at Wardensville and consequently this is the shipping point.

There are three churches, a high and a graded school, one State bank, a flour mill and sawmills. The mail service is daily.

Reymann Memorial Experiment Farms.—The people of Wardensville and vicinity are very fortunate in having located just north of town the Reymann Memorial Farms. The following quotation is taken from the West Virginia University Catalogue for 1924-25:

"Through the gift of Anton Reymann and Paul O. Reymann of Wheeling, West Virginia, executors of the estate of Lawrence A. Reymann, deceased, the University came into possession on March 1,

PLATE XLI.—View looking southeast across the Cacapon River Valley from a point near the Hampshire-Hardy County line north of Wardensville. The immediate foreground is a river wash deposited upon the Marcellus Shale. The valley here is synclinal and in the background the Red and White Medina Sandstones form North Mountain. (Photo by Harris).

1917, of the Lawrence A. Reymann Memorial Experiment Farms, including 930 acres of land on the Cacapon River in Hardy County, and a herd of 94 head of pure bred Ayreshire cattle. The farms are for the use of the Experiment Station for experimental work in all phases of agricultural science. Under co-operative agreements drawn up with the Bureau of Animal Husbandry, United States Department of Agriculture, the farm will be used primarily for dairy breeding investigations. Studies will be made of the comparative value of in- and out-breeding, using tested sires. As this is the best equipped establishment of its kind in the United States and probably in the world, the progress of the work will be watched with interest by livestock men and the results should do much toward answering some very important questions. Other investigations will also be conducted upon these farms as rapidly as the funds will permit.

"During the past three years, a modern dairy barn has been built, with standard equipment, and during the past year a creamery, fully equipped with modern machinery including a refrigeration plant. As no investigations are being carried on with dairy products, the milk is converted into whatever product finds the most ready market. Since the winter of 1922-23 sweet cream has been placed daily on the Washington City market. Prior to that time the milk was converted into full cream cheese."

Villages.

Lost City.—This village is located in the Lost River Valley in the southeastern part of the county, approximately twenty-one miles southeast of Moorefield, the county-seat, and twenty miles southwest of Wardensville, the nearest banking point. Another of the Union Tanning Company plants is located here. According to W. R. Orndorff this plant gives employment to about fifty people, with an approximate monthly pay-roll of $3,000. Both tan bark and extract are used. Since there are no railroad facilities, the raw hides and tanned leather must be hauled by truck approximately thirty miles south to Broadway, Virginia. The capacity of the plant is 166 sides (83 hides) daily. Only sole leather is manufactured. Of the 50 employed, 30 are skilled laborers.

Mathias.—This is another village located along the Lost River Valley in the southeast part of the county, four miles south of Lost City. It has an estimated population of one hundred inhabitants, with daily mail service, and telephone connections. It is well supplied with churches, there being the United Brethren, Dunkard, and Methodist Episcopal.

CHAPTER VII.

PHYSIOGRAPHY.

EVOLUTION OF MOUNTAIN FORMS.

That the present land forms of Hardy County are the results of varied forces is evidenced by the position in which the strata are now found. By a similar process that is taking place in the various epi-continental seas to-day, we know that many of the present surface rocks of sandstones, limestones, and shales were deposited under a considerable depth of water. We also know that the Upper Devonian Shales and most of the overlying Carboniferous sediments to the north and west of Hardy County, by their fossils, markings, and structure, such as ripple-marks and mud-cracks, and occasional coals, as well as coarseness and character of sediments, were deposited in shallow water.

Sediments deposited in water will accumulate in practically a horizontal plane. That the rocks are now found in great arches and troughs is evidence that varied forces have been at work upon them. The disturbances that caused these movements were those of the Appalachian revolution. This revolution was possibly the result of two main causes, one being the loss of balance, due to the shifting of sediments (isostacy) from the positive areas of Appalachia and Acadia, into the negative area of the Appalachian Geosyncline and the other being the shrinkage of the earth's crust as the result of cooling, causing the circumference to shorten by folding.

That the folding took place over a considerable period is evidenced by the streams that have cut directly through large anticlines. Examination will show that as a rule the west limbs are steeper and shorter than those on the east. This was probably due to the less resistant formations on the west as compared to the highly resistant continent of Appalachia on the east.

Work done by former geologists shows that the marked mountain making of the Pennsylvanian continued into the

Permian and culminated with the making of the Appalachians, Ouchitas, and the ancestral Rocky Mountains. The area under discussion, however, has no rocks younger than those of early Mississippian, but it is reasonable to think that the entire Carboniferous as well as the Permian once existed here. If this supposition be true, a restoration of the intervening strata down to the Ordovician shales, which are now exposed in the eastern anticlines, along North Mountain, would form ranges 17,000 to 18,000 feet higher than their present level. If the uplift was gradual, however, there is no reason to believe that erosion did not keep pace with the uplift, and they may not have greatly exceeded their present height.

With the exception of the southwestern States, the seas began to vanish toward the close of the Pennsylvanian, and continued until late Permian time when the continent had nearly all emerged from the sea. Erosion was at work as soon as the land was above water and continued until the close of Triassic time when the mountains had reached a peneplain.

During the late Jurassic period various forces had again elevated the peneplain into a high plateau in the Appalachian area which was to be dissected by the Cretaceous elements, and again practically base-leveled. This same cycle was again repeated in the Late Cretaceous-Early Tertiary. It was in the Late Tertiary that the last important uplift took place. Our present Appalachians are due to the differential erosion that accompanied and followed this uplift. It is reasonable that the various forces now at work will, in time, again bring them down to base-level.

In its geographical position Hardy County lies within the borders of the Allegheny Ridges.

GEOLOGIC HISTORY.

The rocks appearing at the surface within the limits of Hardy County are of sedimentary origin, that is, they were laid down in water. They consist of sandstones, shales, and limestones, all of great variety in composition and appearance. These materials were originally gravel, sand, and mud, derived from the waste of older rocks, chemical precipitates from enclosed seas, and the remains of animals that lived in the seas while the strata were being laid down. Some of the limestones are largely made up of shells of various sea animals. Often the abundance of plant growth, under suitable conditions, will form thick seams of coal. The rocks of Hardy County, however, are nearly all older than the rocks of coal-bearing age.

The rocks reveal the unwritten history of the sedimentation from late Ordovician to early Carboniferous time. From their composition and appearance a great deal can be inferred as to the conditions under which they were deposited. For example, sandstone marked by ripples and cross-bedded by currents, or shales cracked by drying on mud flats, indicate shallow water, while limestones with marine fossils indicate deep water. Not only can the conditions of the sea be determined, but also the character of the adjacent land. If the formations show coarse sand, and pebbles of coarse sand, it would indicate that the adjoining land must be high and the stream gradient rather steep. The pebbles may have been repeatedly redistributed back and forth by wave action over a rising and sinking coast-line. Red sandstones and shales, such as the Bloomsburg of the Silurian, and the Catskill of the Devonian, are indicative of oxidation by being long exposed to the air. If limestones are deposited near the shore the adjacent land must be low, and the streams too sluggish to carry off the coarser sediment.

The seas in which these sediments were laid down covered an extensive area, including the Appalachian province and extending westward to the central States of the Mississippi basin. The sediments were derived from the land to the east of this area, from an old continent known as Appalachia.

Reasoning in this manner it is supposed that during the deposition of the older formations, as the Cambrian and Ordovician, the continent to the east was high and rugged, probably of crystalline origin, the erosion of which furnished the bulk of the sediments for these periods. In the later Silurian deposit of the limestones of the Salina Group, the eastern continent must have been very nearly base-leveled, with a subsiding coast-line, thus permitting a transgression of the sea.

The Devonian Period following the Silurian is one of an abundance of sandstones and shales. It marks another uplift of the eastern land along with some of the recent residual Silurian deposits, followed by a period of erosion.

Following the great deposits of the Devonian sandstones and shales, come the alternating beds of sandstone, limestone, shale, and numerous seams of coal. Only the basal member, the Rockwell Sandstone, remains in Hardy County.

In the columnar section it can be seen that rocks exposed in this area attain a thickness of 13,700 feet.

DRAINAGE OF HARDY COUNTY.

DRAINAGE BASINS.

A general view of the drainage system, in miniature form, of Hardy County can be seen on Figure 10. It can readily be seen that the major streams follow, in general, the trend of the mountain ranges to the northeast, while the minor streams seem to have cut deep gorges across them almost at right angles. There are a few exceptions where the major streams seem to have disregarded the mountain ranges and cut directly across them. This is particularly true of Lost River between Baker and Wardensville. Here the river has cut across the large folds of Oriskany Sandstone with no regard whatever for the strike of the rocks. This can only be accounted for by a gradual rise of the folds and the stream well entrenched in the overlying soft shales before the more resistant sandstone arose above drainage.

Table of Stream Data.

The following table, prepared by Paul H. Price, gives a list of the major and minor streams of Hardy County, with the length of each stream, both meander and air-line, also the total fall and rate of fall per mile in feet being determined. The last column gives the ratio of the total distance (T.D.) to the air-line (A.L.D.).

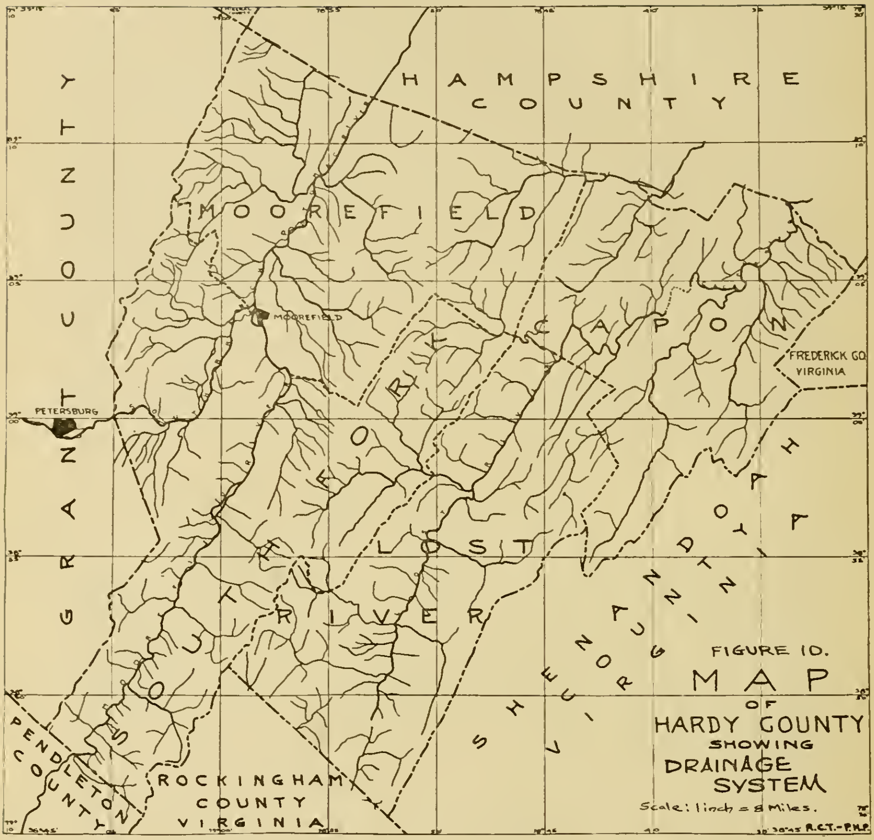
HAMPSHIRE COUNTY
GRANT COUNTY
PETERSBURG
MOOREFIELD
MOOREFIELD
CAPON
FREDERICK CO. VIRGINIA
NORTH FORK
LOST RIVER
SOUTH FORK
SHENANDOAH
NORTH RIVER
SHENANDOAH MOUNTAIN
PENDLETON COUNTY
ROCKINGHAM COUNTY VIRGINIA
FIGURE 10.
MAP OF HARDY COUNTY SHOWING DRAINAGE SYSTEM
Scale: 1 inch = 8 Miles.
R.C.T.-P.H.P.

Table of Stream Data.

Streams	Total Distance. Miles.	Total Fall. Feet.	Rate of Fall Per Mile. Feet.	Air-Line Distance. Miles.	Ratio T. D. to A. L. D.
South Branch Potomac River (Source to Mouth)	131.15	3065	23.37	94.40	1.39
South Branch Potomac River (Source to Hardy Co. Line)	63.15	2710	42.91	49.60	1.27
South Branch Potomac River (Hardy Co. Line to Hampshire Co. Line)	21.5	160	7.44	17.3	1.24
South Branch Potomac River (Hampshire-Hardy Co. Line to Mouth)	47.7	190	3.98	28.4	1.68
Moorefield River (Source to Mouth)	64.4	1800	27.95	52.4	1.23
Moorefield River (Pendleton-Hardy Line to Mouth)	27.2	410	15.08	20.4	1.33
Moorefield River (Source to Pendleton-Hardy Line)	27.2	1325	35.62	32.36	1.14
Stony Run	5.2	1480	284.61	4.6	1.13
Rodabaugh Run	2.7	1170	433.33	2.6	1.04
Rohrbaugh Run	5.1	1630	319.61	3.6	1.42
Dumpling Run (S. F. Dist.)	3.2	1050	328.12	2.5	1.28
Brake Run	4.0	1405	351.25	3.3	1.21
Kade Run	2.2	650	295.45	2.0	1.10
Baker Run	4.0	1405	351.25	3.3	1.21
Shooks Run	3.7	1660	448.64	3.6	1.03
Stump Run	3.8	1440	378.94	3.7	1.03
Lost River (Source to where it emerges)	33.0	1090	33.03	24.0	1.375
Upper Cove Run	6.5	700	107.69	4.7	1.38
Capon Run	2.6	580	223.07	2.2	1.18
Lower Cove Run	6.6	800	121.21	5.3	1.245
Adams Run	2.2	250	113.63	2.1	1.047
Culler Run	7.5	870	116.0	5.6	1.34
Snyder Run	2.7	410	151.85	2.3	1.17
Howards Lick Run	6.0	920	153.33	4.5	1.33
Whitehead Run	1.95	385	197.43	1.6	1.22
Kimsey Run	10.1	1010	100.00	7.2	1.40
Camp Branch Run (S. F. Dist.)	5.1	1095	214.70	3.9	1.307
Gap Run	3.35	825	246.26	2.85	1.175
Trout Run	17.0	1260	74.11	13.1	1.297
Thorny Bottom Run	8.9	620	69.66	7.9	1.126
Halfmoon Run	1.4	515	367.85	1.3	1.076
Waites Run	10.0	1855	185.5	8.1	1.234
Three Springs Run	4.0	690	172.5	3.8	1.05
Sperry Run	7.6	1145	150.65	5.8	1.31

Streams	Total Distance. Miles.	Total Fall. Feet.	Rate of Fall Per Mile. Feet.	Air-Line Distance. Miles.	Ratio T. D. to A. L. D.
South Branch Potomac River:					
Mill Creek (Mostly Hampshire Co.)	14.5	1040	71.72	12.7	1.14
Elmlick Run	5.3	985	185.85	4.6	1.15
Saw Mill Run	6.0	865	144.17	3.5	1.71
Stony Run	4.6	830	180.43	3.2	1.44
Anderson Run	8.8	950	107.95	7.0	1.25
Mudlick Run	6.4	320	50.00	5.7	1.12
Walnut Bottom Run	5.8	1275	219.82	5.1	1.14
Fort Run	7.7	1520	197.40	6.2	1.24
Dumpling Run	7.2	890	123.61	6.2	1.16
Moorefield River:					
Stony Run	5.2	1480	284.61	4.6	1.13
Jenkins Run	4.2	730	173.81	3.7	1.135
Durgon Creek	5.1	585	114.70	3.8	1.34
Mitchell Run	4.6	900	195.65	4.2	1.07
Hutton Run	4.7	815	173.40	4.1	1.146
Falling Spring Run	2.4	1685	702.08	2.0	1.20
Slate Rock Run	3.0	815	271.66	2.8	1.07
Moores Run	8.8	950	108.00	5.8	1.52
Waites Hollow	3.2	775	24.21	3.0	1.066
Water Lick Run	4.3	530	123.25	3.9	1.10
Baker Run	9.2	1680	182.60	6.9	1.33
Camp Branch	5.1	1095	214.70	3.9	1.307
North River	48.5	1275	26.29	29.7	1.63
Skaggs Run	6.4	675	105.47	5.0	1.28
Horn Camp Run	5.4	765	141.66	4.5	1.20
Cacapon and Lost River (Source to Mouth)	110.9	2025	18.28	66.7	1.66

Areas of Drainage Basins.

The following table, prepared by Paul H. Price, gives the planimetric determinations of the areas of the principal drainage basins of Hardy County, the joint topographic sheets of the United States and West Virginia Geological Surveys being used for authority:

Areas of Drainage Basins.

Streams.	Sq.Mi.
Moorefield River (entire)	334.02
Wilson Run	4.77
Rodabaugh Run	2.41
Rohrbaugh Run	9.55
Dumpling Run	4.02
Brake Run	6.92
Stump Run	4.51
Kade Run	1.57
Baker Hollow	1.05
Shooks Run	6.79
Lost River:	
Upper Cove Run	8.84
Capon Run	3.26
Lower Cove Run	12.00
Adams Run	3.95
Culler Run	12.05
Snyder Run	1.81
Howards Lick Run	9.60
Whitehead Run	2.71
Kimsey Run	33.41
Camp Branch Run (South Fork Dist.)	10.83
Mill Gap Run	3.46
Trout Run	48.37
Thorny Bottom	17.75
Brushy Hollow	4.54
Halfmoon Run	1.67
Waites Run	20.36
Three Springs Run	3.40
Sperry Run	15.54
South Branch Potomac River	1492.66
Mill Creek	50.10
Elmlick Run	8.82
Saw Mill Run	14.76
Devils Hole Run	4.89
Stony Run	18.94
Clifford Hollow	12.95
Anderson Run	40.74
Mudlick Run	22.48
Walnut Bottom Run	13.19
Long Hollow	7.06
Toombs Hollow	1.94
Williams Hollow	3.39
Dumpling Run	21.19
Fort Run	13.91

Streams.	Sq. Mi.
Moorefield River:	
Stony Run	7.09
Jenkins Run	5.36
Durgon Creek	8.79
Mitchell Run	4.31
Hutton Run	4.07
Falling Spring Run	1.11
Slate Rock Run	3.75
Waites Hollow	3.47
Moores Run	14.28
Water Lick Run	6.58
Horn Camp Run	11.44
Baker Run	24.38
Camp Branch	7.99
Skaggs Run	8.22
Longlick Run	7.50
Crab Run (Hardy portion only)	5.71
Gravel Run	2.42
North River	210.54

DESCRIPTIONS OF DRAINAGE BASINS.

South Branch of Potomac River.

The South Branch of Potomac River, which with some of its tributaries drains the western side of Hardy County, has its source near Monterey, Highland County, Virginia, and flows in a general northeast direction across Pendleton County, crossing the southeast corner of Grant, entering Hardy just east of Petersburg, continuing in the same general direction across Hardy and Hampshire Counties to French Station (South Branch P. O.) where it joins with the North Branch of the Potomac to form the Potomac River. It has a total length from source to mouth of 131.15 miles with a fall of 3065 feet or an average of 23.37 feet per mile. The greatest fall, however, takes place before the Hardy County line is reached, as the rate of fall per mile from its source to the Hardy line is 42.91 feet, while the rate of fall from the Grant-Hardy line to the Hardy-Hampshire line is only 7.44 feet, and from here to its mouth the rate of fall is only 3.98 feet per mile. The South Branch of the Potomac River has a total drainage area of 1492.66 square miles.

In general, the South Branch follows the trend of the mountains, but occasionally it leaves what appears to be its natural course, such as a synclinal valley with soft shales, to cut directly across a resistant sandstone anticline. This is accounted for by the fact that the stream had entrenched itself in the overlying softer shales, and the folding did not take place so fast but what the stream could cut it away as fast as it arose. The stream enters Hardy County under these conditions, cutting through an Oriskany anticline just east of Petersburg, forming Petersburg Gap. It then continues northeast along a shale outcrop to Moorefield where it is joined by the Moorefield River. From Moorefield northeast the South Branch meanders leisurely across soft shale outcrops for six miles where it enters between two sharp Oriskany folds, called "The Trough". For the next eight miles its course is determined by the steep walls of these folds, and after emerging from the "Trough" it is within the limits of Hampshire County. Thus it continues across Hampshire in a northeast direction until its union with the North Branch at French Station (South Branch P. O.).

The South Branch has two large tributaries, the North Fork and Moorefield River, (earlier called the South Fork) with many smaller streams, each of which will later be described.

Anderson Run.—Anderson Run with its tributaries drains the northwest part of the county. There are two principal tributaries, Mudlick and Walnut Bottom Runs. In computing the length of Anderson Run, the Walnut Bottom was taken as the main stream. It heads at Huckleberry Ridge on Patterson Creek Mountain. The Mudlick branch heads at Old Pine Church near the Hampshire-Hardy boundary. Anderson Run empties into the South Branch 1.25 miles northeast of Old Fields. Its total length is 8.8 miles with a total fall of 950 feet.

Moorefield* River.

The stream now mapped as the Moorefield River was known and mapped for a long time as the South Fork of the South Branch of the Potomac River, and locally still goes by that name. To prevent misunderstanding and repetition of names the National Board of Geographers changed the name from South Fork to that of Moorefield River.

Moorefield River has its source in Highland County, Virginia, between Bull Pasture Mountain and Shaw Ridge, or approximately two and one-half miles south of the Pendleton County line, and flows in a northeasterly direction entirely across Pendleton and continues into Hardy to Moorefield where it joins the South Branch. Its course has been largely determined by the lay of the rocks, and is confined almost entirely to the soft Lower Devonian shales with a steep, resistant sandstone embankment on the west.

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*Since the maps were engraved and the volume in type the Geographic Board has changed the name of the Moorefield River to South Fork. See Letter of Transmittal by State Geologist.

Moorefield River is a comparatively small river and has no tributaries of any importance. It has a total length of 64.4 miles with a fall of 1800 feet, or an average of 27.9 feet per mile. It has an air-line distance of 52.4 miles with a ratio to the meandering length of 1.00 to 1.23.

Stony Run is a small run that has its source on the west side of South Branch Mountain and empties into the South Branch of the Potomac River at McNeill. This run has a larger tributary in Swartz Run that flows through Clifford Hollow east and north of Potato Row. Stony Run has a meandering length of 5.2 miles with a total fall of 1840 feet.

Fort Run rises on the west side of South Branch Mountain directly east of Moorefield and flows in a general northwest direction for a distance of 7.7 miles with a total fall of 1520 feet and enters the South Branch of the Potomac River three miles north of Moorefield.

Rohrbaugh Run has its source on the west slope of South Branch Mountain and flows west for a distance of 5.1 miles where it enters the Moorefield River at Peru with a total fall of 1630 feet.

North River has its source on the east side of South Branch Mountain just north of Fabius and flows in a general northeast direction to one mile north of Inkerman where it turns directly east along the Hampshire-Hardy County line to one mile east of Rio. Here the Oriskany Sandstone of North River Mountain determines the course of the stream which is approximately N. 30° E. The river follows the west side of this fold its entire length to the Forks of Cacapon, where the sandstone plunges beneath the Marcellus Shales and permits the North River to join the Cacapon River.

North River has a meandering length of 48.5 miles with a total fall of 675 feet.

(For a further description see Hampshire County.)

Cacapon and Lost River are one and the same thing, the latter name being used to designate the stream before it sinks into the ground, about four miles west of Wardensville, and the former name to designate it after its emergence. This stream has its source in the extreme southeastern part of Hardy County near the Virginia line and follows a northeasterly course across the eastern portion of Hampshire County and across the west central part of Morgan to the Potomac River at Great Cacapon Station on the Baltimore and Ohio Railroad. The air-line distance from its source to its mouth is 66.7 miles while by the river channel the distance is 110.9 miles.

PLATE XLII.—A view of Lost River at the point where it goes down, taken shortly after a rain. The water here is ponded because the underground passageways are unable to take care of all the water. (Photo. by Harris).

In general this river follows an outcrop of Marcellus Shales on the west limb of an Oriskany anticline to one mile north of Baker where it turns directly east across numerous folds of Oriskany Sandstone. Approximately four miles west of Wardensville the river has cut an underground passage in the Helderberg Limestone and remains underground for about three miles where it emerges and continues directly east to Wardensville. Here the river assumes an old-age character and meanders with ox-bows lazily across the Marcellus Shales, with the Oriskany folds marking the eastern border, and continues in a northeasterly direction into Hampshire County.

(For further description see Report on Jefferson, Morgan and Berkeley Counties, also Hampshire County of this Report.)

Waites Run has its source between North Mountain and Paddy Mountain just west of Sugar Knob and flows in a general northerly direction, cutting across North Mountain southeast of Furnace. Here the stream course is determined by the steep slopes on either side, and flows north to the Cacapon just below Wardensville.

Trout Run rises near the Virginia line in a canoe-shaped basin between North Mountain on the east and Long Mountain on the west. It flows in a northeasterly direction for seven miles, where on seeking an outlet it turns to the northeast across massive folds for three miles, where it again follows the trend of the folds to Wardensville where it joins the Cacapon River. Trout Run has a total length of 17 miles with a total fall of 1760 feet.

Baker Run has its source high up on the east slope of South Branch Mountain at Sand Spring and flows in an easterly direction across the Upper and Middle Devonian sandstones and shales for a distance of 9.2 miles where it empties into Lost River at Baker. This run has a fall of 1680 feet.

Baker Run has a tributary in Camp Branch that rises on the east side of South Branch Mountain and just east of Sand Spring, and empties into Baker Run at Needmore.

Kimsey Run has its source on the western slope of the southern end of South Branch Mountain and on the northern end of Shenandoah Mountain. It flows in a northeasterly direction for a distance of four miles where it turns eastward circling the northern end of Hunting Ridge and is joined by Camp Branch at Holly Hill Church. It continues eastward, cutting Big Ridge and Little Ridge at right angles, to the village of Lost River where it empties into Lost River.

Lower Cove Run rises high up on the rugged ridges of North Mountain. It flows in a southwesterly direction to Mountain View School where it is joined by Adams Run coming in from the south. The stream continues west, cutting the vertical Medina Sandstones at right angles and joining Lost River at Lost City.

Howards Lick Run is formed by several small branches that have their source on the west slope near the top of the northern end of Shenandoah Mountain, and flows in a southeasterly direction, cutting the ridges at right angles and joining Lost River at Mathias. Where the stream cuts through the ridges it leaves steep precipitous slopes.

Upper Cove Run rises in the southern end of a canoe-shaped basin between Cove and North Mountains. It flows northeast between the two mountains to Basore where it turns to the northwest, cutting through the vertical Medinas of Cove Mountain to join Lost River at Mathias. Upper Cove Run has an air-line distance of 4.7 miles while its meandering length is 6.5 miles, with a fall of 700 feet.

Culler Run, the head tributary of Lost River, has its source near the divide between Lost River and James River. The branches, however, rise on the west slope of Shenandoah Mountain and meander through and around prominent ridges to join with Lost River two miles south of Mathias. Culler Run has a meandering length of 7.5 miles with a fall of 870 feet.

CHAPTER VIII.

GEOLOGY.

INTRODUCTION.

The rocks exposed in Hardy County range in geological age from near the base of the Martinsburg Shale, of the Ordovician Period below, up into the Rockwell Sandstone portion of the Pocono epoch, of the Mississippian Period. The rocks, as here exposed, have an average aggregate thickness of 14,000 feet.

These Paleozoic sediments vary in mode of formation from marine, through estuarine, to continental.

The entire system of rocks is strongly folded into many anticlines and synclines, which have a general axial trend between north and northeast. Toward the east portion of the county folding is more intense than toward the west, and in general the inclination of the limbs of the folds is greater toward the east side of the county than toward the west side.

Exposures of the older, (Ordovician), rocks are confined to the three canoe-shaped anticlinal valleys, in the eastern portion of the county, just west of the Virginia State line. The youngest rocks of the county, on the other hand, occupy two great synclinal highlands, which trend northeast-southwest through the central portion of the county. The rocks of intermediate age, the Silurian and Devonian, are to be found between the older rock areas on the east and the younger rock areas in the central portion of the county, and again on the western border of the county.

The greatest elevations occur in the central portion on South Branch Mountain Syncline, where, in the heavy Pocono sandstones, a few miles north of Helmick Rock there are elevations of over 3300 feet. The next highest mountain elevations occur along the eastern border of the county on North Mountain and on Paddy Mountain. There are many elevations in the White Medina Sandstone in these mountains exceeding 3000 feet and a few which exceed 3100 feet. Bald Knob, on Short Mountain Syncline, in the north-central portion of the county, reaches an elevation of 2890 feet, while Elkhorn Rock, toward the southwestern portion of the county, on the Grant County line, is over 3000 feet, and High Knob on Mill Creek Mountain in the northwestern part of the county, on the Hampshire County line, is over 2600 feet.

The lowest elevations in the county occur in the Moorefield valleys, along South Branch and its tributaries, (the South Branch of the Potomac and the Moorefield River). These tributary valleys vary in elevation from about 770 feet near the north at McNeill to about 900 feet on the Grant County line northeast of Petersburg and to about 1280 feet at the Pendleton County line in the Moorefield River Valley. The Wardensville valley, in the northeastern part of the county, and the Lost River Valley, in the east-central part of the county, are each much smaller than the Moorefield valleys. The Wardensville valley ranges in elevation from 950 feet, on the Hampshire County line, to 1150 feet, two miles south of Wardensville. The Lost River Valley is less eroded than either of the valleys already mentioned, and ranges from 1350 feet to 1400 feet in elevation.

With the exception of the flat lands of the few valleys mentioned, the county is in topographic maturity, so that a large portion of the rain-water is lost by flood during the rainy spells, and agriculture is largely confined to the river lowlands, while many of the highlands are heavily forested. This is especially true in the eastern portion of the county, which is more distant from railroads and improved highways. The Shenandoah National Forest occupies a considerable portion of this eastern area.

STRUCTURAL GEOLOGY.

Hardy County occupies a position toward the west side of the belt of folded Appalachians. Its western border is within ten miles of the relatively flat-lying rock area of one of the Allegheny Plateau coal fields, while its eastern border is in the complexly folded and locally overturned rock area of the North Mountain district. In general the structure of the Hardy County rocks becomes more complex toward the east.

There are probably a few faults which cut the sedimentary deposits of Hardy County in the areas of vertical and overturned rock on the western sides of the unsymmetrical anticlines, especially in the eastern part of the county, but so far none have been definitely worked out, and if such occur they probably have small displacements.

All the larger folds, anticlines and synclines, are complex in character, and have smaller folds superimposed, so that in reality the larger folds are geanticlines and geosynclines. There is a tendency in most of the folds to be unsymmetrical. This is especially noticeable toward the eastern side of the county, where folding has been more intense. Toward the western part of the county, or in the area of rocks which were less resistant to lateral pressures, (incompetent strata), folds are narrower, shorter, and more numerous. Many of the folds in this portion of the county are practically symmetrical in cross-section and have small dip (are open rather than closed folds).

The authors have not attempted to show on the structure sections these numerous small folds which occur so commonly in the areas of incompetent strata.

Of the structures mapped there are 8 anticlines and 8 synclines which are sufficiently well developed to be conspicuous for more than ten miles within the county. The synclines are broader as a rule than the anticlines. This is well shown in the three structure sections. In cross-section A-A′, the sharp Pine Ridge Anticline is flanked on the east by the broad, complex, synclinal trough, extending to Long Mountain and on the west by the much broader syclinorium which extends to the Moorefield Valley, a distance of about twelve miles. This broad synclinorium is made up of three well-defined anticlines.

Cross-section B-B′ shows a larger synclinorium occupying the east-central portion, with another broad shallow synclinorium between Elkhorn Mountain Anticline and the Grant County line.

Cross-section C-C′ shows the structure to be for the most part synclinal.

PENEPLAINS AND TERRACES.

A careful study of the topographic maps, cross-sections, and field notes reveals the fact that there are several peneplains in Hardy County which are worthy of note:

The highest peneplain noted in the county is one which has an elevation at the Allegheny Front, about 12 miles west of the county line, of from 3800 feet to 4000 feet. In Hardy County it is between 3200 feet in the central portion, South Branch Mountain, and about 3000 feet on the eastern border of the county in North Mountain.

The next lower peneplain has an elevation of from 3200 feet to 3500 feet in North Fork Mountain, 7 miles west of the county line. In Elkhorn Mountain it has decreased in elevation to a little over 3000 feet, in Shenandoah Mountain to 2700 feet to 2800 feet, and in North Mountain, about one-third the distance from the east side of the county, to 2600 feet.

PLATE XLIII—View of terrace boulder along Moorefield-Petersburg road, 1.2 miles south of Moorefield and 10 yards below road forks to Fisher.

On Patterson Creek Mountain, on the border of the county, there are many elevations of about 2500 feet to 2600 feet. On Hunters Ridge, which is a little more than half-way toward the east side of the county, there are many elevations on hilltops which are between 2400 feet and 2500 feet. It would seem that this likewise represents a peneplain which, however, is less well defined than those previously mentioned.

Peneplain elevations of from 1900 feet to 2000 feet a little northeast of Moorefield decrease in the Mathias region to about 1750 feet.

In the Middle Mountain synclinal area to the southwest of Moorefield there are many isolated elevations of about 1300 feet to 1350 feet and corresponding to these on the east side of the Moorefield valleys 5 miles east are many isolated elevations of about 1250 feet.

There are a number of less extensive and lower elevated plains, largely confined to the Moorefield valleys, which seem to be due to rejuvenation, at various times, of the present river system. These terraces are well shown about Moorefield. The highest one is about 1050 feet, is well dissected, and rests upon a more prominent terrace of about 1000 feet. These terraces as well as the lower and very prominent one of a little over 900 feet elevation are well shown in Plate XLIV. Between the last-named terrace and the present river flood-plain at Moorefield there is a well-developed low terrace with elevation of about 820 feet on which the town of Moorefield is built.

Of the various peneplains mentioned the highest corresponds to the Cretaceous Peneplain of Davis. The others would require more study to make sure of their identification.

Figure 11 represents an east and west section through Hardy County and the eastern portion of the county to the west and shows the more prominent peneplains of the area. It will be seen that there is a general eastward inclination to these peneplains of about the same amount per mile, averaging from 30 feet to 40 feet. The upper peneplain is probably the Cretaceous Peneplain of Davis. The ones below have not been worked out. Between the upper peneplain and the second there is an interval of about 400 feet, between the second and third about 500 feet, between the third and the fourth a little over 400 feet, and between the fourth and fifth there is about 700 feet.

DESCRIPTION OF PLATE XLIV.—The view is looking down the South Branch of the Potomac River from a point near the river but across the valley from Moorefield. Several terraces are well shown. The white houses in center background of the picture stand on the same terrace as Moorefield, about 820′ elevation. The houses on higher ground, in the left center of the picture, are on the terrace a little over 900 feet. The long even-topped terrace in the right background is 1,000 feet above sea-level, and farther down the river the slight elevations on this level, as also the high and nearer ground in the left center, represent remnants of the highest well-marked stream terrace in the Moorefield Valley, 1050 feet.

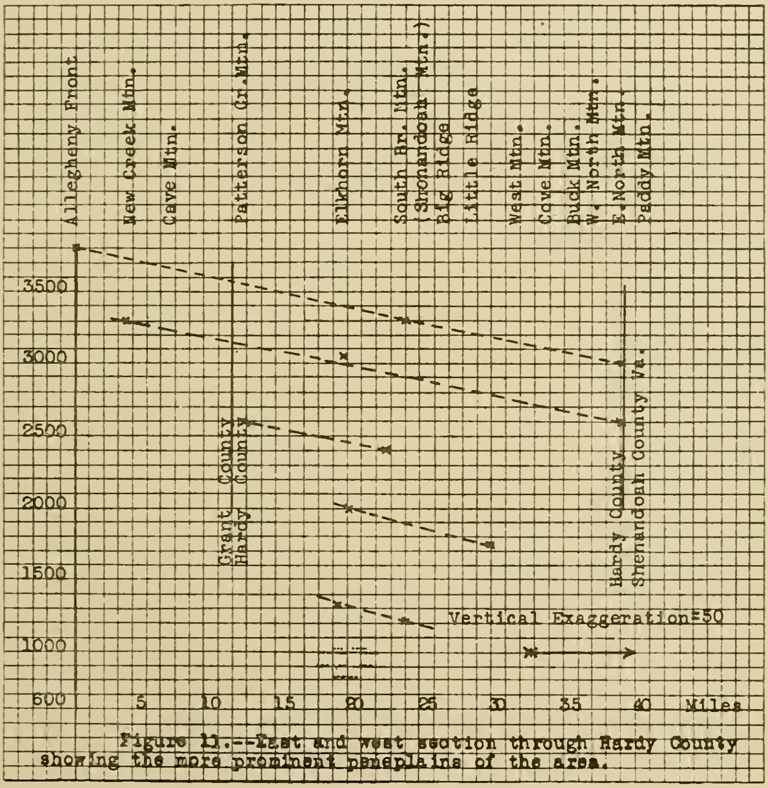


Figure 11.--East and west section through Hardy County showing the more prominent peneplains of the area.

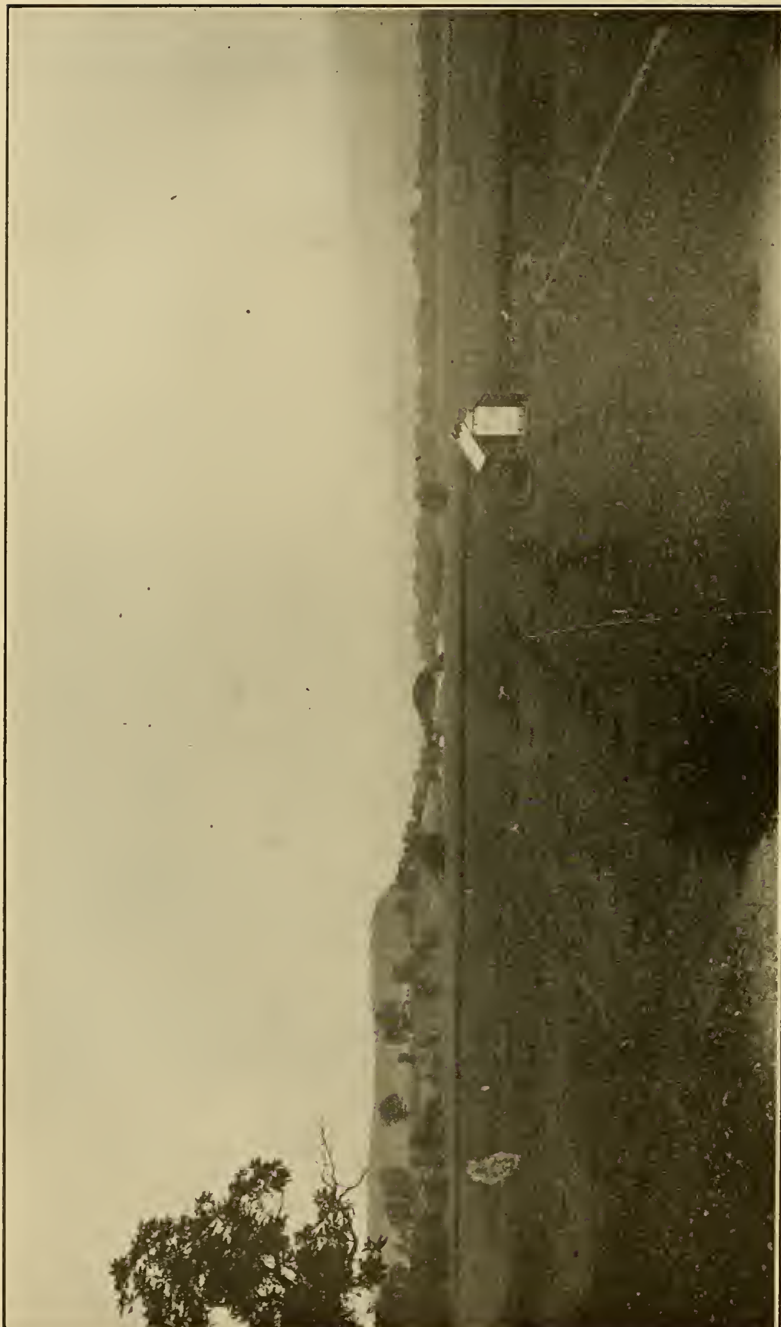


PLATE XLIV.—View looking down South Branch of Potomac River from a point near the river but across the valley from Moorefield. Several terraces are shown. (See paage 207 for description of plate).

The more extensive peneplains not only have a slope to the east but they also have a slope to the north, which would go to show that the main drainage lines of the old peneplains were in general not very different from the present drainage, in other words, it would seem that the main drainage was to the north of Hardy County as now and that the slope of the main streams was toward the east. Either this is the case or there has been differential elevation of the old peneplains.

The terraces on the east and west banks of the streams draining the Moorefield valleys have the same elevation but rise rather uniformly in an up-stream direction, and show conclusively that they were formed by the present stream system. All these stream terraces have heavy pebble and boulder beds buried a few feet below the finer alluvial deposits, forming the top of the terrace. Some of these boulders are of large size, occasionally one three feet or more in diameter being seen (see Plate XLIII).

ANTICLINES AND SYNCLINES.

ELKHORN MOUNTAIN ANTICLINE.

This fold is well developed in the two counties to the southwest of Hardy, and at its point of entrance into Hardy County, a little southwest of Elkhorn Rock, it has reached its greatest structural elevation. From this point on to the northeast it decreases rather regularly until it dies out entirely about a mile to the east of Moorefield.

Looking south from Moorefield this anticline is seen to be a well-defined ridge, rising above the Moorefield valley level rather abruptly, from the point where the anticlinal axis is cut by the Moorefield River, two and a half miles southeast of Moorefield, and continuing as an ascending and nearly perfect arch of Oriskany Sandstone, for about four and a half miles. At this point erosion has cut through the resistant sandstone in the center of the arch and the high ridge, held up by the sandstone and chert of the Oriskany and the upper Helderberg, is split into two ridges which get lower and lower on the flanks of the mountain toward the southwest. The lower Helderberg and upper Silurian limestones and shales, being easily eroded, allow the formation of a valley in the center of the anticline. These depressions are, however, of minor importance because of the increasing elevation of the very resistant lower Silurian sandstones, which rise in the center of the arch to form the well-defined axial ridge.

PLATE XLV.—View looking southeast from Elkhorn Mountain near Brake, across Moorefield River Valley to Shenandoah Mountain and Flattop Mountain in the distance. (For description of plate, see page 211).

DESCRIPTION OF PLATE XLV.—View looking a little south of east from Elkhorn Mountain near Brake, across Moorefield River Valley to Shenandoah Mountain and Flattop Mountain in the distance. Between the Moorefield River Valley and the observer, occur rocks from the Marcellus, down, in the geological column, to the Bossardville. The white rock cliff to right of center of the picture is the Oriskany, immediately overlying the Helderberg. Going up the slope on the far side of the valley we have first the Hamilton, followed by a narrow strip of Genesee, then the Portage and Chemung. The red shales and sandstones of the Catskill come in about three-fourths of the way to the top, and form the surface outcrop from this point on to the southeast for five miles. The rocks to the east of the valley have a low dip, as can be seen in the surface topography, the hills do not have a well-defined trend to the northeast, but have many lateral ridges.

leading southwest to the high point of Elkhorn Rock (made of White Medina Sandstone) on the Grant County line.

This anticline is typical of many in this and bordering counties, in that it is canoe-shaped, is a mountain in so far as its axis is held up by a resistant rock but tends to become a valley in such places as the resistant rock is removed and the easily eroded rocks beneath are encountered. In this area, as elsewhere in the Appalachian region, the Medina Sandstones are the last resistant rocks to be found, as one goes down in the geological column, until the Cambrian is reached. In such areas, therefore, where the Medina arch has been cut through by erosion, there is nothing to stop the downcutting of the agents of erosion, and the centers of the arches become valleys, while the limbs of the anticlines are held up by the resistant sandstones. Under such conditions erosion tends to form anticlinal valleys and synclinal hills. Such we have toward the east side of the county.

BROAD TOP (STRATFORD RIDGE) ANTICLINE.

This anticline is well developed in Hampshire County. West of Romney it forms a high ridge, which is here pierced by a small branch of the South Branch of Potomac River and the Northwestern Turnpike. Southwest from Romney the Green Spring-Petersburg Branch of the Baltimore and Ohio Railroad follows the east flank of the Broad Top (Stratford Ridge) Anticline until it dies out about five miles south of the Hardy County line at Old Fields, about five miles north of Moorefield.

Throughout its course this fold is complex, being in reality an anticlinorium (see Figure 12). This is more marked, perhaps toward the south end of the fold in Hardy County, where the Oriskany Sandstone arches of the minor folding finger out in the shaly flat lands of the Moorefield valley.

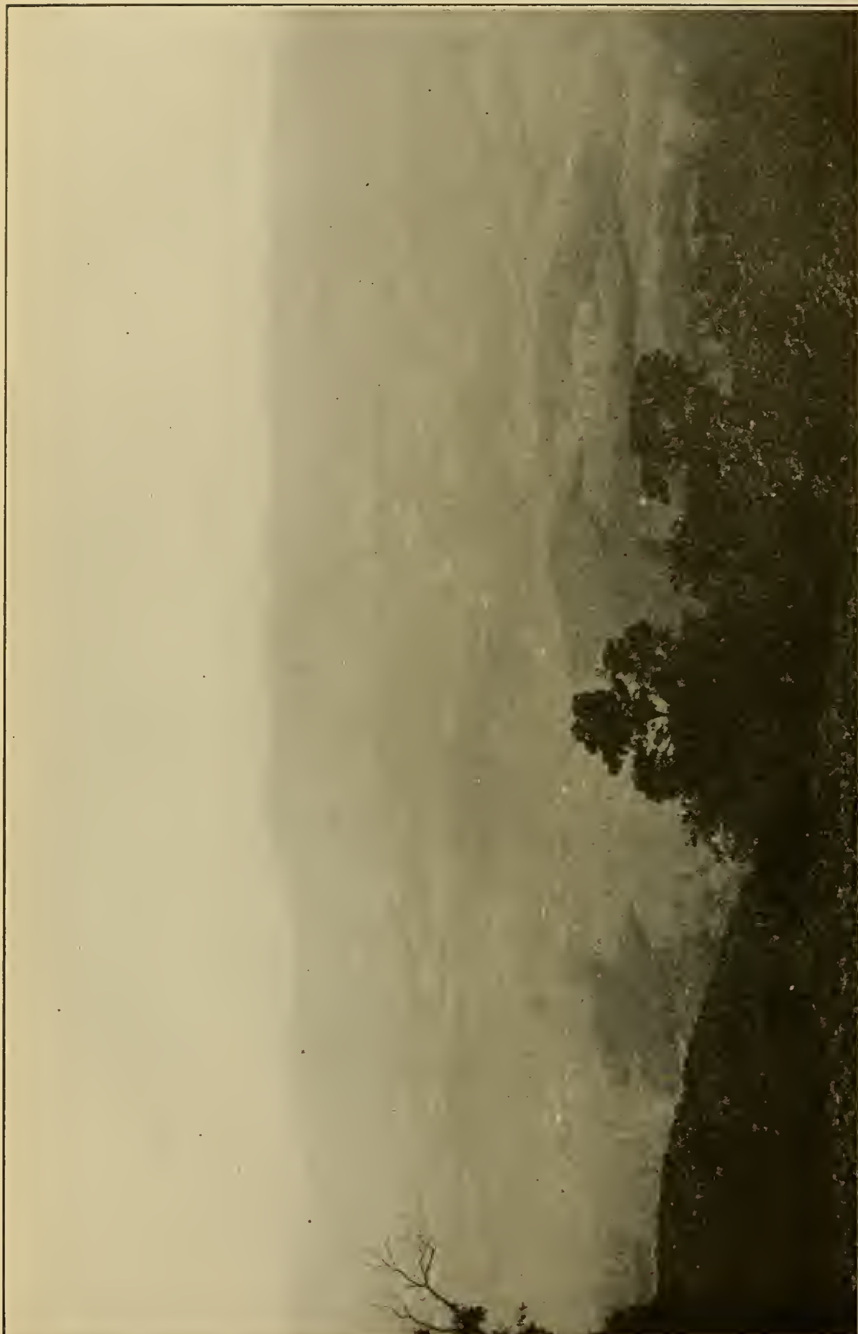


PLATE XLVI.—View looking from High Knob on county line on Broad Top (Stratford Ridge) Anticline, across Clearville Synclinal Valley, to Patterson Creek Mountain Anticline. (For description of plate, see page 213).

DESCRIPTION OF PLATE XLVI.—View looking from High Knob on county line on Broad Top (Stratford Ridge) Anticline, across Clearville Synclinal Valley to Patterson Creek Mountain Anticline. In the center of the picture, the rock is Portage, the center of the left edge is Hamilton, with the Genesee coming in between. The foreground at the foot of the hill and the distant lowland is Marcellus. This completes a practically symmetrical synclinal with its gentle plunge toward the northeast.

The nature of the rocks outcropping in this valley is responsible for the topography. Both the Marcellus and the Genesee, being argillaceous shales, are very easily eroded and tend to form the lowest grounds in the picture while the upper Genesee, the Hamilton, and the Portage, being slightly more arenaceous, tend to form the minor elevations seen in the picture.

Here occur three well-defined minor arches. Along the county line through High Knob the same characteristics are to be seen. (See section through High Knob, Figure 12).

High Knob is in reality a synclinal elevation. The basin structure has brought the Oriskany Sandstone down so low here that the extensive erosion of the area has as yet been incapable of removing it entirely. At this locality, then, we have the resistant lower portion of the Oriskany and the equally resistant New Scotland Chert layer together, capping and protecting from erosion the soluble Helderberg Limestone below.

The western limb of the anticline is, throughout its course in Hardy County, relatively steeply inclined. In places the New Scotland Chert layer and the associated lower Oriskany Sandstone stand up in a vertical wall many feet in height. This same type of wall is seen to better advantage and rising to much greater height in the western limb of Elkhorn Mountain, just to the east of Durgon (see Plates XLVII and XLIV).

Immediately to the east of the Broad Top (Stratford Ridge) Anticline in Hardy County and also for three miles to the north of Hardy County in Hampshire County, is a most unusual parallel anticlinal fold, which forms Sawmill Ridge. This anticline is separated from the Broad Top (Stratford Ridge) Anticline by a very narrow and sharp syncline (Trough Syncline). Through this narrow "Trough" pass the South Branch of the Potomac and the Green Spring-Petersburg Branch of the Baltimore & Ohio Railroad, the valley being scarcely wide enough to accommodate both the railroad and the stream. Throughout the length of the "Trough" the rocks on either side rise with a very steep dip, in places vertical. At Sector P. O. (Glebe Station), which is at the extreme north end of the "Trough", the Oriskany Sandstone rises vertically on the east limb of the anticline.

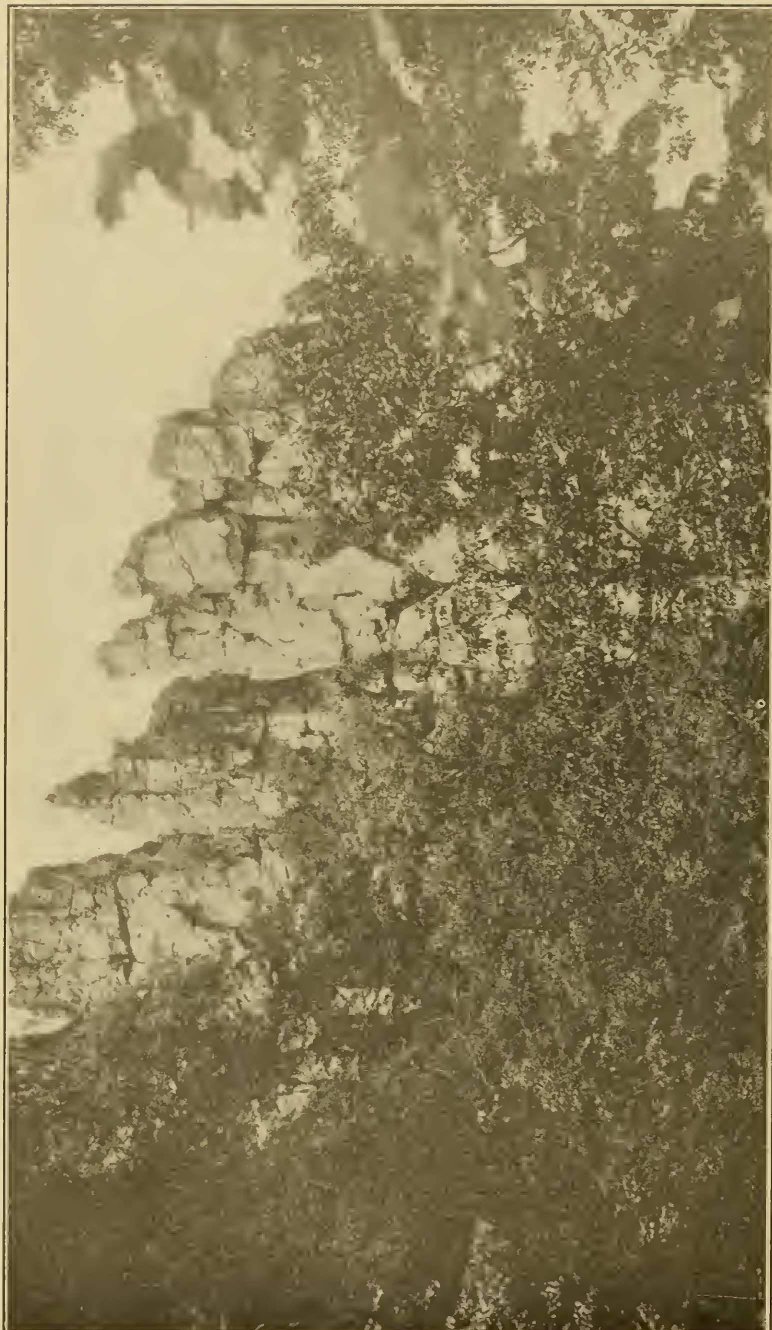


PLATE XLVII.—"Wall rock", view looking west. West limb of Elkhorn Mountain Anticline, 2 miles east of Durgon. This is a different view of the same "wall rock" (Oriskany) seen in Plate LXIV.

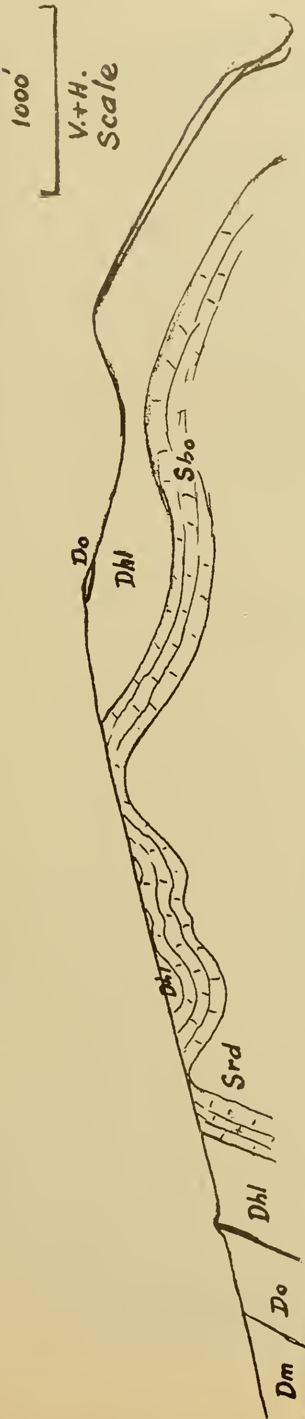


FIGURE 12.—Section of Mill Creek Mountain, through High Knob. This section is typical of most of the anticlines in Hardy County in that it has much minor folding which involves the competent sandstone layers as well as the less competent shales and limestones.

It will be seen from the above description that the Broad Top (Stratford Ridge) Anticline is a complex anticlinal fold, in many places steep on both limbs and with three or more anticlinal arches. One of these minor arches is cut through on the Moorefield-Romney pike at Reynolds Gap (Plate LXVI) and the other two, less well-defined folds nose out just to the northeast of Old Fields.

KESSEL ANTICLINE.

This well-developed, though rather short, anticlinal ridge occurs in the western part of the county, about two and one-half miles east of the axis of the Patterson Creek Mountain Anticline. It extends 9 miles north and 2 miles south of Kessel. At its southwest terminus, there is a slight offset from the northeast terminus of the Welton Anticline, which extends into Hardy County from the south.

The Kessel Anticline reaches its greatest elevation about two and one-half miles northeast of Kessel. Here it is 1750 feet in elevation, or 950 feet higher than the level of the Moorefield valley just to the east. Throughout its course, this anticline is held up by the Oriskany Sandstone, which has not been completely dissected at any point. Like most of the anticlines in the county, it is complex. At Kessel it is divided into two minor folds by a shallow syncline, which brings in a little basin of Marcellus Shale, just west of the Kessel store. Toward the north, the anticline splits into two branches, the eastern one being more prominent and extending farther north, while the western branch, being made up of two minor folds, is less elevated and ends in the Marcellus Shale cover in two short, branching noses.

The road over this anticline from Moorefield to Walnut Bottom School exposes the Shriver Chert portion of the Oriskany. Just to the northeast of Walnut Bottom School along this road, and just beneath the Marcellus Shale cover, the Oriskany has a few streaks of black chert, similar to that found so abundantly in the lower portion of the Oriskany. The rocks are nearly vertical along this contact and there may be a thrust-fault of small throw at this locality, which brings up the cherty layers of the lower Oriskany, otherwise the lithological characteristics of the Oriskany are slightly different from characteristics observed elsewhere in the county. A swampy and springy area at the foot of the hill a few yards to the west would seem to support this fault theory.

Just west of Kessel and the small syncline (Hiser), the western portion of the anticline is well exposed in a beautiful arch about 300 feet across the base and about 55 feet high.

PLATE XLVIII.—An anticlinal fold in which the surface slope and the dip are the same. 1¼ miles west of Old Fields. (See page 218 for description of plate).

DESCRIPTION OF PLATE XLVIII.—An anticlinal fold in which the surface slope and the dip are the same. Such small anticlinal hills are common to the northwest of Moorefield, where the incompetent shales have allowed minor folding and where the Marcellus Shales have but recently been removed from the Oriskany Sandstone arches. These Oriskany Sandstone arches make favorite places for peach orchards. 1¼ miles west of Old Fields. The pond in the left foreground is artificial and is used to float logs to the sawmill, just to the left of the picture.

In this arch the softer, top layers of the Oriskany have been eroded, and the more compact and resistant layer, which is so often ridge-forming, occurs at the top. This layer shows well-developed compressional jointing but no tension joints, which would tend to prove that this sandstone was buried relatively deep at times of folding and that the region has undergone extensive erosion.

PATTERSON CREEK MOUNTAIN ANTICLINE.

The Patterson Creek Mountain Anticline starts a little to the southeast of Petersburg, in Grant County, and continues in a northeast direction, through the southwest corner of Hardy County. At the county line is has become a sufficiently well-developed fold to bring to the surface the upper portion of the Silurian rocks. As this anticline is traced to the northeast it is seen to pass approximately along the line between Grant and Hardy Counties, locally in Grant and elsewhere in Hardy. In this course, the arch rises, until, within about four miles of the Hampshire County line, the Niagara and the Clinton Shales are exposed in the center of the arch. From this point on toward the Hampshire County line the fold decreases in its elevation. Between this point of maximum elevation in the structure and the Grant County line, there are two other areas of relatively longitudinal arching, one such area occurring about 3.5 miles to the northeast of the southwest corner of Hardy, and the other about midway between the Grant County line and the Hampshire County line, so that while the anticline as a whole increases in elevation toward the northeast, it has three well-defined reversals within the borders of Hardy County. The two smaller longitudinal arches expose the Rondout Formation.

As the name of the anticline suggests, it is topographically as well as structurally an arch, and forms a natural division between the two counties. The chief rocks exposed on the anticline are limestones, of either upper Silurian or lower Devonian age. The cherty portion of the Helderberg and the resistant, overlying sandstones of the Oriskany have been completely worn away from the crest of this anticline

PLATE II.—View of Patterson Creek Mountain from Mill Creek Mountain, just below High Knob, 5½ miles distant. The picture is taken from near the Hampshire-Hardy County line and is looking about due west toward Wililamsport. The lowest gap in the hills about in the center of the picture shows the position of the Moorefield-Williamsport road, which passes through the Patterson Creek Mountain Anticline, in the area of the highest structural arching and the weakest rock exposures. The county line is about one-fourth the distance from the right end of the picture. Toward the north, or right, the mountain is seen to decrease in elevation and become more regular. This is due to the plunging of the anticline in that direction and to the less dissection of the Oriskany Sandstone which covers the ridges to a greater extent in that direction. About one-fourth the distance from the left end of the picture is another depression, which in turn marks another structural arch in the ridge with its attendant greater erosion in the weaker, underlying formations. The heights of land to the north and to the south of this last-named depression are in structural synclines, the one to the south, or on the left edge of the picture, being held up by the Oriskany Sandstone running to the crest of the anticline, just to the north of Huckleberry Ridge. (See Geological Map of the county and also description of Patterson Creek Mountain Anticline, page 218).

in Hardy County, with one exception, and that in a small area between five and six miles northeast of the Grant County line. Here there are a few small patches of the Oriskany still remaining on the hilltops and one fairly continuous tongue, which rises from the east flank of the anticline, narrowing as it rises, until it is completely lost by erosion just on the west side of the county line on Huckleberry Ridge.

Plate IL shows a large portion (about 12 miles in length) of the Patterson Creek Mountain Anticline. The picture was taken from High Knob on Mill Creek Mountain, 5.5 miles distant and is looking about due west toward Williamsport. (See geological map). The lowest gap in the hills, about in the center of the picture, shows the position of the Moorefield-Williamsport road, which passes through the Patterson Creek Mountain Anticline in the area of the highest structural arching and the weakest rock exposures. The county line is about one-fourth the distance from the right end of the picture. Toward the right, or north, the mountain is seen to decrease in elevation and become more regular in outline. This is due to the plunging of the fold toward the northeast and to the less dissection of the Oriskany Sandstone, which covers the ridge more completely in that direction.

About one-fourth the distance from the left end of the picture is another depression, which in turn marks another structural arch in the anticline with its attendant greater erosion in the weaker underlying formation. The heights of land to the northeast (right) and to the southwest (left) of the last-named depression, are in structural synclines, the one to the left (southwest) being held up by the Oriskany Sandstone, running to the crest of the anticline, where one of the minor cross-fold synclines is superimposed on the Broad Top (Stratford Ridge) Anticline.

It is evident from the above description that there is a definite relationship between rock character and structure, and topography.

SAWMILL RIDGE ANTICLINE.

This is one of the minor anticlines in the county. It occurs just to the east of the Broad Top (Stratford Ridge) Anticline from which it is separated by the very narrow and steep-sided synclinal valley of the "Trough" Syncline which is the northward extension of the Middle Mountain Syncline of Grant County, to the southwest of Hardy County.

Sawmill Ridge Anticline extends about 4.5 miles in Hardy County and about 3 miles in Hampshire County. This anticline forms a high mountain ridge capped throughout its entire length by the Oriskany Sandstone, which plunges beneath the surface along the southwest extension of the axis at McNeill, along the Petersburg and Green Spring Branch of the Baltimore & Ohio Railroad. The north end of the anticline is beautifully exposed just to the east of Sector Post-Office (Glebe Station) where the Romney road and Sawmill Run cut through the Oriskany arch, which here is very narrow and nearly symmetrical. The highest portion of the arch and the highest point topographically on this anticline is about 1.5 miles south of the Hardy-Hampshire County line, where the ridge reaches an elevation of nearly 1700 feet. On the highest portion of this anticline is located an extensive peach orchard which thrives in the calcareous and cherty soil of the lower portion of the Oriskany formation here exposed by erosion.

This anticline, like most of the others in this locality, is composed of minor folds. This is more especially true in the central and southwestern portion of the anticline.

SUGAR KNOB ANTICLINE.

The Sugar Knob Anticline is the most northerly of the three folds which occur on the eastern border of Hardy County. This fold has a length of 5 miles in the county, and extends on to the northeast with increasing axial elevation into Frederick County, Virginia. The southern terminus of the anticline is also just over the line in Shenandoah County, Virginia. Just before the anticline reaches the Virgina line, toward its southern terminus, it widens slightly and the two minor anticlines, which go to make up the main anticline farther to the north, become more prominent and divergent, so that as in the case of the north end of the Anderson Ridge Anticline, just north of the Ordovician outcrop, we have a rather abrupt ending for most of the anticline, but with an anticlinal tongue extending from the east side of the anticline over the Virginia line for some distance. Where the Virginia line cuts across the anticline it is largely in the White Medina outcrop with the exception of the eastern tongue of the anticline which brings up the underlying Red Medina.

The Ordovician (Martinsburg) shales occupy the central portion of this anticline from the county line on the north to within less than a mile of the county line on the south. This outcrop has an average width of about 1.25 miles. The Medina Sandstones form the height of land both to the east and to the west of this Ordovician valley. To the east is Paddy Mountain and to the west is North Mountain.

CRAB RUN ANTICLINE.

The Crab Run Anticline is a minor fold which enters Hardy County from Rockingham County, Virginia, between West Mountain Syncline and Sideling Hill Syncline. This anticline continues but a short distance into the county before it is practically lost in a number of smaller parallel folds which can be traced to Mathias or a little farther northeast.

ANDERSON RIDGE ANTICLINE.

Like the Adams Run Anticline, this structure is one of the canoe-shaped folds occurring along the Virginia-West Virginia border. It is like the Adams Run Anticline also in that the older rocks in its higher structural portion are of Ordovician age (Martinsburg Shales), and that these shales occupy an erosional valley surrounded by Medina Sandstone ridges (Long Mountain on the west and North Mountain on the east). The Martinsburg Shales have a length of outcrop, in this structure of about 7 miles, with an average width of outcrop of about 1.5 miles. The anticline points out to the southwest with a well-defined nose, but toward the northeast the structure becomes divided into one fairly large and other smaller anticlines and synclines, so that in the Martinsburg valley of Trout Run the main anticlinal axis passes northeastwardly through the crest of Anderson Ridge to just east of Wardensville, where it dies out by the plunging of the Oriskany Sandstone cover beneath the incompetent Marcellus Shale with its many minor folds. In this northern extension of the anticline from the Martinsburg valley there is for a good portion of the way toward its end at Wardensville a secondary anticline on the eastern flank of the main anticline. This deflection of the main anticlinal axis to the west, just at the north end of the Martinsburg valley and the introduction of the minor folds to the northeast, causes the abrupt and obtuse ending of the Martinsburg outcrop and also causes the White Medina Sandstone highland, immediately to the northeast, to trend at right angles to the axial direction of the anticline and separate the Martinsburg valley portion of the Anderson Ridge Anticline from the Meadow Branch Syncline immediately to the northeast in the headwaters of Trout Run.

ADAMS RUN ANTICLINE.

The Adams Run Anticline is the most southwesterly of three large anticlines which occur en echelon along the eastern border of the county, which is the line separating West Virginia from Virginia. The offset character of the anticlinal axes accounts for the peculiar offsets or jogs in the State line,

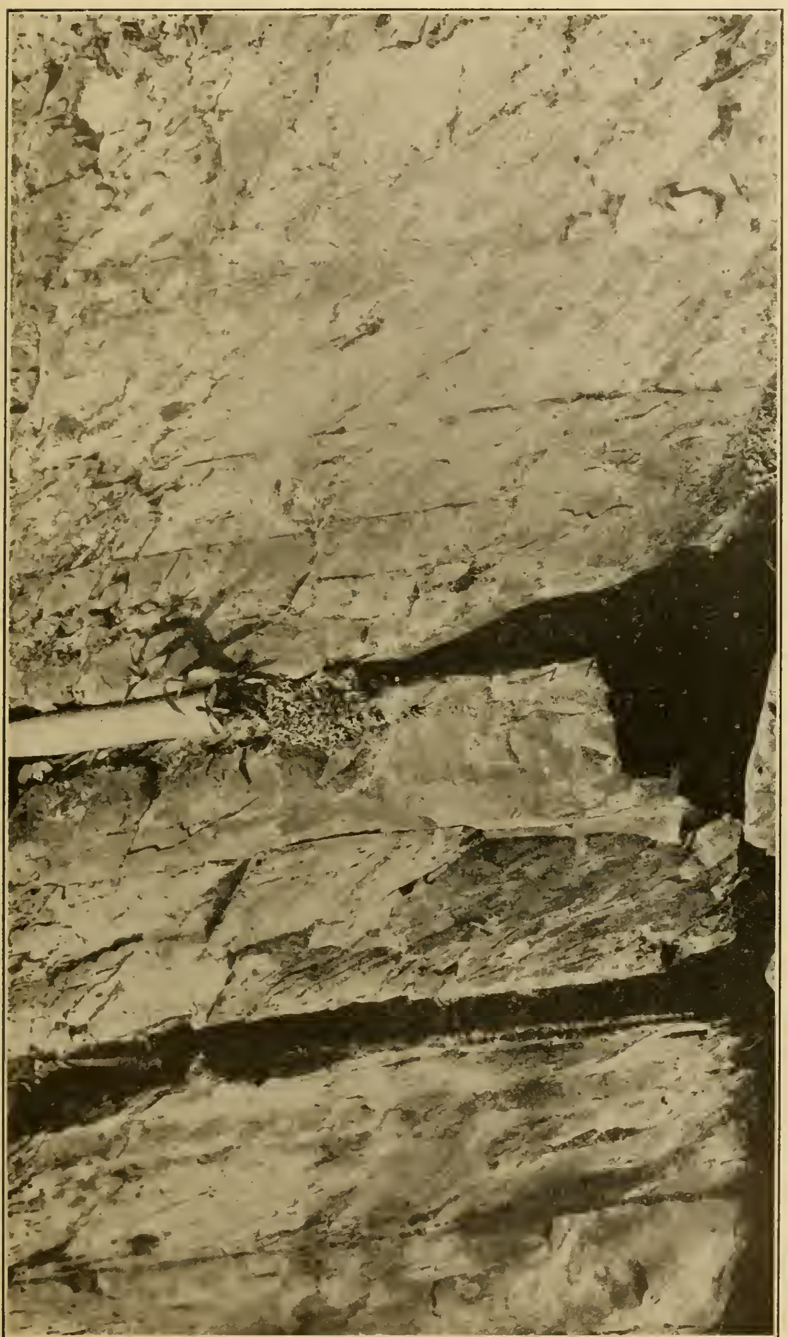


PLATE L.—Interbedded shales and sandstones on the west limb of the overturned Adams Run Anticline 2 miles east of Lost City. The shales have a fracture cleavage different from the bedding-plane. For details of the cleavage and its relation to the bedding, see Figure 13.

since the structural characteristics are reflected in the topography and the topography in turn largely governs the position of the State line. Here as in many other places the higher ridges or watersheds were chosen for the location of boundaries.

The Adams Run Anticline enters Hardy County from the southwest as a well-developed structure. Its axis extends parallel with and about a mile west from the West Virginia-Virginia State line for a distance of about 14 miles. The structure ends rather abruptly in a double anticlinal fold, one fork of which ends about three, and the other about five miles due east from Lost City.

In this anticlinal we have the largest continuous exposure of the Ordovician rocks in the county. Toward the southwest this exposure has a width of about three-fourths of a mile and toward the northeastern end of the structure the outcrop width is in places as much as 2.25 miles. Throughout practically the entire length of the anticline the western limb is overturned and the arenaceous shales show a decided fracture structure. (See Figure 13 and Plate L). As in all anticlinal structures in this part of the State which expose the Martinsburg Shales, we have a height of land surrounding the Martinsburg outcrop, on account of the more resistant character of the Medina (Silurian) Sandstones than the underlying and valley-forming Martinsburg Shales and Sandstones.

The Red Medina Sandstone, capped by the very resistant White Medina Sandstone, forms Cove Mountain to the west of the anticline and North Mountain to the east of the anticline. This highland rim is in many places more than 3000 feet in elevation.

WHIP COVE (EAST) ANTICLINE (PAW PAW ANTICLINE, MD.?)

The Whip Cove (East) (Paw Paw of Maryland ?) Anticline extends about three-fourths the distance across the county from the central portion or the north county line, where it comes in from Hampshire County and is provisionally correlated with the Paw Paw Anticline of Maryland. For the most of its course through the county this anticline is well defined and nearly symmetrical in cross-section. For two-thirds of its length it has rather steep dips but toward the southwest end the inclination of the strata on its flanks becomes modified and within 4 miles of the south line of the county the strata grade into the flat rock area of the Shenandoah Mountain district.

The persistence and uniformity of this anticline may be explained by its occurrence in the more competent Upper Devonian sandstones and arenaceous shales, rather than in

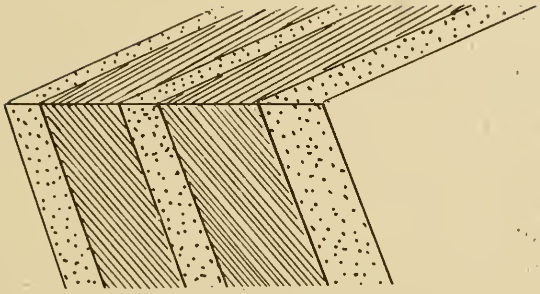


FIGURE 13.—The drawing represents a section through overturned, interbedded shale and sandstone of Martinsburg age in the Adams Run Anticline, two miles southeast of Lost City. The shales were relatively incompetent strata and during the process of folding and overturning, fracture cleavage occurred in the shales, while the sandstones were not noticeably affected. The dip of the beds is 70 degrees. The cleavage dip is 50 degrees. The strike of the beds is N. 25° E., while the strike of the cleavage is N. 8° E.

From this figure we can get the information that the location of exposure is to the west of the axis of the anticline and that the forces of compression were acting in a direction not quite parallel with the direction of dip.

the older, more limy, and shaly, and formerly more deeply buried strata.

Throughout its length the anticline exposes the Chemung strata with a width of outcrop varying from 0.75 mile to a little over a mile. This Chemung belt is bordered on either side by a wide outcrop of the higher Devonian Catskill, which in places is capped by the Pocono.

On either side of this anticline is a well-developed syncline. The one on the east (Sideling Hill Syncline) extends throughout its course and even beyond it to the southwest, while the one to the northwest (Whip Cove Syncline) extends about the same distance in a southwesterly direction but is not quite as extensive as is the anticline in the northeasterly direction. Both these synclines are about two miles distant from the anticlinal axis. The dips on the limbs of this anticline are 60 degrees or more in many places. In fact, the average dip from the axis of the anticline to the axis of the bordering synclines, where crossed in the neighborhood of Needmore, is from 60 to 45 degrees.

HANGING ROCK ANTICLINE.

The Hanging Rock Anticline is one of the more extensive folds of Hardy County. It enters the county at a point about 4.5 miles northwest of Wardensville and extends into the county a distance of about 15 miles or to about 2.5 miles northeast of Lost City.

Lost River, one of the main branches of Cacapon River, cuts through this anticline at Hanging Rock, the point of its highest structural arch. Here the White Medina rises to elevations of over 1900 feet both to the northeast and to the southwest of the Hanging Rock section and the Red Medina is brought up in a small exposure in the center of the arch along the highway and the stream.

At Hanging Rock section, the western limb of the anticline is considerably steeper than the eastern limb. The Oriskany on the west has a dip of about 80 degrees and the shaly formations occurring southwest, along Lost River Valley, are standing well on edge. The Medina, Clinton, and Niagara, on the east side, have dips from about 40 to 50 degrees. The Bloomsburg Red Sandstone, on the east side of the anticline has three separate and parallel lines of outcrop, due to a secondary anticline, parallel with the main one and about 0.6 mile southeast of it. Similar but less marked minor folding is to be observed on the west limb of the anticline in the relatively incompetent Helderberg and Bossardville Limestones. These minor folds are accompanied by crumpling and some minor faulting.

About 5 miles to the southwest of Hanging Rock, the anticline dips down to such an extent that the Bossardville Limestones form the crest. From this point on toward Lost City it rises again and the Bloomsburg Red Sandstone forms the crest. Between Lost River and Lost City the anticline disappears in the steeply inclined and overturned strata on the west limb of the Adams Run Anticline.

WHIP COVE (WEST) ANTICLINE (OF MARYLAND).

The Whip Cove (West) Anticline of Maryland enters Hardy County from Hampshire County about midway between the east and west extremities of the north line of Hardy and extends about ten miles into Hardy County in a southwesterly direction. The northern four miles of the anticline in the county brings up the Chemung shales and sandstones, but the down-flexing of the axis of the fold allows the Catskill red sandstones and shales to occupy the surface above the axis of the fold for four miles to the southwest, where the anticlinal axis again rises sufficiently to bring the Chemung formation to the surface. This second arching of the axis is not extensive and the anticline soon plunges to the southwest, where it is entirely lost in the wide outcrop of the Chemung, about 3.5 miles east of Moorefield.

BAKER MOUNTAIN ANTICLINE.

This structure enters Hardy County from a point 5.5 miles northwest from the northeast corner of the county and extends to the southwest a distance of about 20 miles where it joins the small northwestern branch of the Adams Run Anticline at a point 3 miles east from Lost City. Throughout the larger portion of its course this structure is rather inconspicuous and affords no prominent elevation except in the northern three miles, where the axis rises rapidly to the northeast and is capped by the resistant Oriskany Sandstone. In the course of this structure in the county the Bossardville is brought up in two small areas, the Oriskany in six areas, the Helderberg in four, and the Marcellus in one.

This anticline is flanked on the east side by the Wardensville Syncline and on the west by the Sandy Ridge Syncline. Both of the flanking structures have minor dips, so that the Baker Mountain Anticline and the two lateral synclines go to make up a synclinorium between the conspicuous Anderson Ridge Anticline on the east and the Hanging Rock Anticline on the West.

WHIP COVE SYNCLINE.

This structure is largely confined to Hardy County and lies just to the west of the Whip Cove (East) or Paw Paw Anticline, and from which it is distant from 1.5 to 2.25 miles.

This structure is a much less elongated canoe-shaped fold than the Sideling Hill Syncline and on this account the synclinal mountains toward the center of the structure are higher both topographically and geologically. The Pocono Sandstone group, which begins at Helmick Rock on the south, caps the syncline toward the northeast for a distance of over 9 miles to a point just south of the crossing of the Moorefield-Wardensville highway. In the center of this syncline, the Pocono Sandstone reaches an elevation of 3220 feet. At this point the Pocono basin has a width of 1.25 miles.

At the north county line the Whip Cove Syncline is nearly pinched out between the Whip Cove (East) Anticline on the east and the Whip Cove (West) Anticline on the west.

Southwest from Helmick Rock the syncline flattens and within 6 miles the rocks become nearly flat in the Shenandoah Mountain area.

MIDDLE MOUNTAIN SYNCLINE ("TROUGH" SYNCLINE OF NORTHERN PART OF COUNTY).

The Middle Mountain ("Trough") Syncline has an extended course to the southwest of Hardy County since it has been traced in this direction across Grant and well into Pendleton County. It enters Hardy County at a point 4 miles southeast from Petersburg, Grant County, and continues across Hardy into Hampshire County. In the northern portion of Hardy and the southern portion of Hampshire County, it forms the deep and narrow "Trough" Syncline, through which pass the branch line from the Baltimore & Ohio Railroad and the South Branch of the Potomac River.

The syncline deepens toward the southwest and holds in consequence, in its axial portion, the geologically younger formations. On the south county line the Portage occupies the center of the trough with a width of outcrop of 1.5 miles. The Portage ends rather abruptly at about 5 miles northeast of the county line, due to the decrease in elevation of the axial portion of the syncline. The Genesee continues along the axis for about one mile to the northeast before the rising axis brings up the Hamilton. From this point on toward the northeast for 2 miles the axis of the syncline flattens, so that the Hamilton Shale outcrop along the axis is extended for about 4 miles before the underlying Marcellus Shale is brought to the surface. From this point on to the "Trough" the syncline is largely in the alluvial bottom lands of the South Branch of the Potomac. In entering the "Trough" the Oriskany is brought to the surface and forms not only the bottom of the "Trough" but also the sides. Here the topography and the structure are practically the same. At Sector Post-Office at the north end of the "Trough" the anticline on the east side of the "Trough" gives out and as a result the syncline becomes the eastern limb of the Broad Top (Mill Creek Mountain) Anticline which is here immediately to the west.

TOWN HILL SYNCLINE.

This syncline enters Hardy County from the north, 4.5 miles northwest of Rock Oak, as a well-developed, broad structure and extends into the county for a distance of about 9 miles or to Sugarloaf Knob, a little over 3 miles northeast from Moorefield. For more than half its length south from the north line of Hardy County this syncline maintains an axial elevation of nearly 2900 feet. The rocks exposed in this syncline are the Catskill and Chemung shales and sandstones. The Catskill rocks have a width of outcrop at the county line of three miles and continue southward as a narrowing belt

PLATE LI.—View showing south end of "The Trough" from a point west of McNeill looking northward toward Sycamore. Sawmill Ridge is to the right and Mill Creek Mountain to the left.

PLATE LII.—View of "Trough".

for 8 miles, where the rising synclinal axis brings up the underlying Chemung.

CLEARVILLE SYNCLINE.

The Clearville Syncline enters Hardy County from Hampshire County at a point 2.7 miles southeast from the northwest corner of Hardy County. This structure has a decided plunge toward the northeast. For 2.6 miles southwest from the county line the Portage rocks occupy the center of the syncline. Within the next 1.6 miles to the southwest the Genesee and the Hamilton are passed through, the latter near the Bethel School. From here, on to the Grant County line, a distance of about 11.2 miles, the axis of the syncline is practically flat and the synclinal basin narrows and shallows and is often nearly lost in the minor folding in the Marcellus Shale which forms the surface rock. In the northern portion of this structure the Marcellus valley to the east has one fairly persistent minor fold and several less extensive smaller ones.

WEST MOUNTAIN SYNCLINE.

The West Mountain Syncline enters Hardy County from Rockingham County, Virginia, 3.5 miles northwest of the southeast corner of the county, as a double syncline with the eastern fork of the structure less well-developed than the western one. The folds die out not far from the Hardy County line, the eastern one within about 1.5 miles and the western one within about 3.5 miles. This structure has the Chemung rocks capped in a few isolated and higher places by small patches of Catskill, Bald Knob being one of these.

SIDELING HILL SYNCLINE.

The Sideling Hill Syncline is more extensive than any other structure in Hardy County. It completely crosses the county in a northeast and southwest direction, a little east of the center and continues on into Hampshire County to the north. In fact, the syncline has a very small plunge to the northeast throughout the Hardy County area, so that the younger and higher rocks are best exposed in this structure toward the northeastern part. For seven miles southwest from the north line of the county, in Short Mountain, the Pocono sandstones and shales occur in the center of the syncline, but from here southwest, through Big Ridge and Flattop Mountain, to the southern line of the county, a distance of 19.5 miles, the Catskill red sandstones and shales cover the axis of the fold. Throughout the entire length of the fold in the county the Catskill-Chemung line is distant from the axis of the fold more than a mile, and in places two miles.

The tendency of the structure to widen in the direction of the plunge of the axis is compensated for by the increased dip of the beds in the structure toward the north, and as a result, the line of contact of Chemung and Catskill in the two sides of the structure are practically parallel. The continuity of this structure as well as that of the two anticlines bordering it and the syncline to the west of it, is in large part explained by the fact that these folds occur in the more competent sandy beds of the upper Devonian and also that they were less deeply buried at the time of folding than the rocks now exposed in any other portion of the county.

Bald Knob of Short Mountain held up by the Pocono sandstone, in the northern portion of syncline, reaches an elevation of 2890 feet. There are many points southwestwardly from here along the synclinal ridge which exceed 2700 feet. In fact, the southwestern portion of this structure, where the rocks are flattening out into the general flat rock Shenandoah Mountain area, has higher elevations than in its central portion in the county.

MEADOW BRANCH SYNCLINE.

The Meadow Branch Syncline is the most northeasterly structure in Hardy County. The axis of this fold enters Hardy County from Hampshire, about 2 miles northwest from the northeast corner of Hardy County, and continues southwestwardly for about 9 miles, or to the north terminus of the east branch of the Anderson Ridge Anticline.

This structure has a decided plunge to the northeast and displays along its axis all the formations from the White Medina (Tuscarora) Sandstone to the Chemung, the latter of these forming a narrow strip extending southward from the Hampshire County line about 2.6 miles.

The nosing out of the Anderson Ridge Anticline near Wardensville allows the syncline to spread out considerably northeast from this point, while the syncline to the southwest from here is considerably pinched and narrowed.

WARDENSVILLE SYNCLINE.

This syncline is named from the town of Wardensville which is located in it. This structure is one of the less well-defined ones in the county. It is very shallow and also has very irregular boundaries. The only rock exposed in this basin, outside of the alluvial deposits, is Marcellus Shale. As in most deposits of this incompetent material, there are numerous minor folds.

The structure practically dies out by Mollys Hill, 4.5 miles southwest of Wardensville, but comes in again after the saddle is passed and extends on as a narrow and shallow structural basin for a distance of over 8 miles, or to a point 3 miles east of Lost City.

SANDY RIDGE SYNCLINE.

The Sandy Ridge Syncline extends from the north county line at a point 4.5 miles west of Wardensville to a point 2 miles due east from Lost City. For the greater portion of this 12.5-mile course the rock exposed in the structure is largely Oriskany Sandstone and it is also largely a horizontal attitude, but with numerous small basins and arches. This structure is between the well-defined Hanging Rock Anticline on the west and the poorly defined Baker Mountain Anticline on the east.

Because of the general flat-rock character of the country in this syncline and the loose-grained character of the Oriskany Sandstone, which is the chief rock type occurring in it, the soil is as a rule sandy and the roads through the more elevated portions, in the higher Oriskany, quite sandy and hard to travel.

It is in this structure that the Lost River sinks and runs for a distance of about two miles underground. The loose Oriskany sand and sandstone overlying the soluble Helderberg Limestone make easy the loss of water from the stream and the formation of solution channels, which, during a portion of the year, are sufficiently large to carry the entire flow of the stream, but which are not capable of accommodating the stream at high water.

THE ORDOVICIAN PERIOD.

According to Dr. E. O. Ulrich and others, the Ordovician is subdivided into the following epochs, beginning at base: Chazyan, Mohawkian, Cincinnatian. Each of these larger divisions is subdivided into two groups: the Chazyan into the Stones River below and the Blount above, the Mohawkian into the Black River below and the Trenton above, and the Cincinnatian into the Eden below and the Maysville above.

The exposures of Ordovician in Hardy County are in the upper portion of the system. The Eden and the Maysville divisions of the Cincinnatian are both well represented.

Rocks of Trenton age probably occur in the Martinsburg of Hardy County but the exposures studied did not reach sufficiently deep to yield Trenton fossils.

MARTINSBURG SHALE.

General Character.—As far as seen, the Martinsburg group of rocks is composed of arenaceous shales and interbedded thinner sandstones, but lacks, in these exposures, the limestone beds which are common in the rocks of this age farther southwest in the Catawba Valley, Virginia, and the Pearisburg, Virginia-West Virginia, district.

In the three anticlinal areas of its outcrop in Hardy County, the Martinsburg is usually overturned on the west limb of the anticline and also here shows fracture cleavage. Such fracture cleavage is seen in Plate L and in Figure 13. from an exposure a little west of Mountain View School. This exposure shows dip of bed 80° E. and dip of fracture cleavage of 50° E. There is also a difference of strike of the two planes, the beds reading N. 25° E. and the fracture cleavage N. 8° E.

Thickness.—Measurement of the Martinsburg Shale from Mountain View School westward toward Lost City shows a thickness of a little over 1000 feet (See section, page 337). This does not represent the full thickness of the formation here.

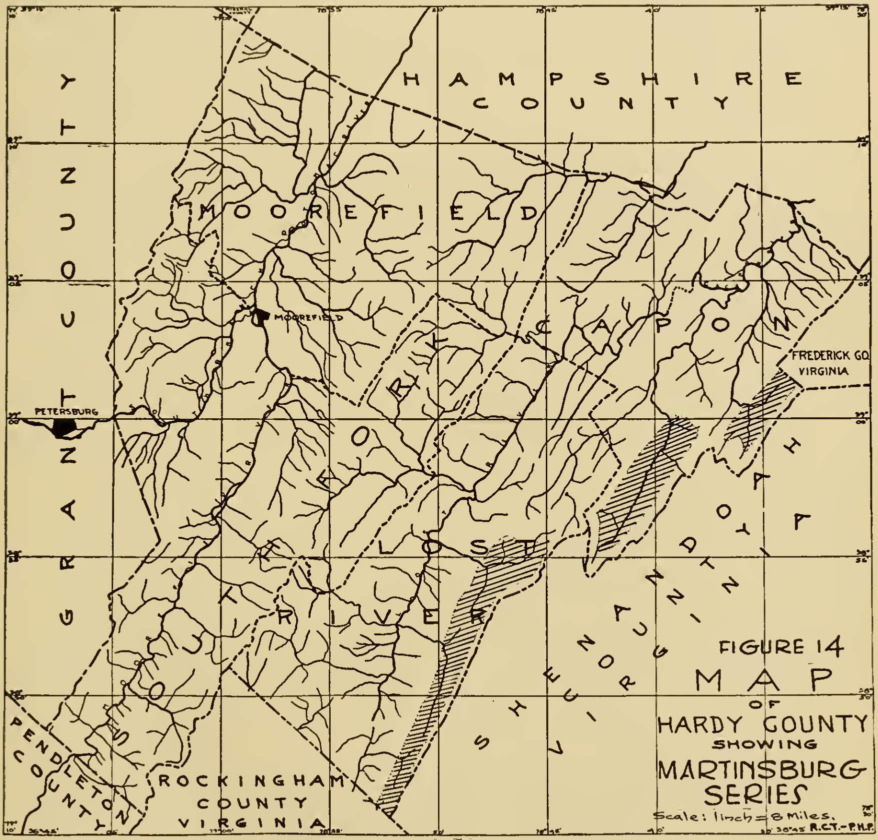
These three areas have a combined exposure of Martinsburg (Ordovician) Shale of about 20 square miles.

Topography.—From the nature of the topography of these valleys, the Martinsburg Shale formation is largely covered by drift rock from the more resistant sandstones of the mountain fringe.

Areal Extent.—The rocks of this age in Hardy County are confined to three relatively long and narrow anticlinal valley areas in the eastern part of the county. The three anticlinal valleys which carry the Ordovician rocks are overturned, canoe-shaped folds, with rather steeply dipping rocks. These folds, in ground plan, overlap one another (en echelon) along the Virginia border, each offset making a corresponding notch in the West Virginia-Virginia boundary. The southwestern of these three Ordovician areas, whose center is about 2.5 miles southeast from Mathias, is the most elongate and overturned. In this valley the Ordovician rocks have an average width of outcrop of from 3/4 to 2 miles and a length in the county of 13 miles.

The central anticlinal area is structurally the least extensive of the three. The Ordovician rocks have here a width of outcrop of two miles and a length of exposure of seven miles. The southwestern end of this anticlinal valley is about seven miles due east from Lost City.

The following outline map of Hardy County, prepared by Paul H. Price, shows the areal extent of the Martinsburg Series in Hardy County:



The third area of outcropping Ordovician rocks in the county begins about 2.5 miles to the southeast of the north end of the last-mentioned Ordovician area and extends northeastward to and beyond the Frederick County, Virginia, line, a distance of four miles.

All three valley areas of outcropping Ordovician rocks are enclosed by massive Medina Sandstones. These valleys are bounded on the west respectively by Cove Mountain, Long Mountain, and North Mountain and on the east respectively by West North Mountain, East North Mountain, and Paddy Mountain.

Contacts.—The contact between the Martinsburg and the Gray Medina is not easily distinguished in the unweathered rock, but weathering brings out a very distinct color change. The upper portion of the Martinsburg is highly fossiliferous while the Gray Medina immediately above is without fossils.

Fossils.—No fossil collections were made in the Martinsburg, but field studies show both the Maysville and Eden members to be present, though with less abundant fossils than in the counties to the south and west.

Fossils identified in the field are as follows:

Coelenterata

Diplograptus cf. vespertinus (Ruedemann).

Molluscoidea

Brachiopoda

Dalmanella multisecta (Meek).
Lingula nicklesi Bassler
Orthorhynchula linneyi (James).
Plectambonites rugosus Meek.

Arthropoda

Isotelus cf. stegops (Green).

Subdivisions.—Lithologically and faunally the exposed Martinsburg is subdivided into two parts, a top arenaceous shale and sandstone with abundant Maysville fossils and a more shaly portion below with Eden fossils.

Economic Aspects.—The shales are too sandy to be of much value except as surfacing for roads. The sandstones are not suitable for building purposes. Unlike many of the Martinsburg areas farther to the west, there is practically no limestone in the shales and the resultant soils are less fertile than in these other areas.

SILURIAN PERIOD.

The Ordovician-Silurian boundary has long been a bone of contention, nor does the problem seem yet to be settled to the satisfaction of all. The Maryland Geological Survey[1] in its recent publication on the Silurian of Maryland, places the line between the Gray and the White Medina, while Reger[2] in the Mineral and Grant County Report of the West Virginia Geological Survey draws the line between the Gray Medina and the Martinsburg Shales.

The following outline map of Hardy County, prepared by Paul H. Price, shows the areal extent of the Silurian Rocks in Hardy County:

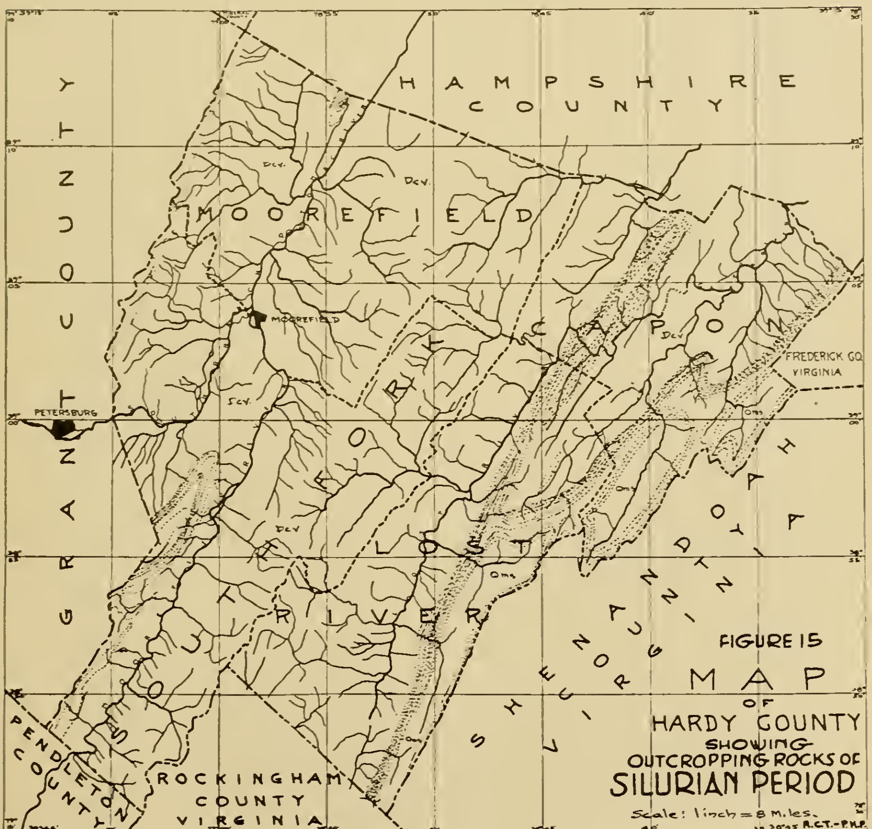


FIGURE 15
MAP OF HARDY COUNTY SHOWING OUTCROPPING ROCKS OF SILURIAN PERIOD
Scale: 1 inch = 8 miles.

The upper boundary of the Silurian is fairly well agreed upon, at the present time, as the base of the Helderberg.

In the present Report the base of the Silurian is taken as the bottom of the Gray Medina. The reasons for this view are stated on pages 240 and 242, under the discussion of the Gray and the Red Medinas.

The Silurian, as thus delimited, begins in Hardy County with gray sandstones, put down, for the most part at least, as shallow water or shore deposits, from a land mass to the east, and shallow-sea conditions farther to the west in Ohio, Illinois, and Kentucky. The Red Medina beds which follow suggest rapid sedimentation with poor sorting of the materials, much of the sedimentation taking place as estuarine or land deposits. The occasional gray bed in the Red Medina indicates a return in sedimentary condition to that of the Gray Medina. During the following epoch the shore-line of this sea shifted into the Hardy County area and we have as a result the white water-worn sandstones of the White Medina (Tuscarora) which represent the shore phase of the transgressing sea. With the deepening of the waters we have a deposition of shales and sandstones of lower and middle Clinton time, containing abundant marine fossils. With the further spread of marine conditions we have the more calcareous beds of the Upper Clinton (Rochester), where present, with their abundant marine life. From this point on the Silurian sediments show the effect of slowly retreating sea conditions of a halting character, during which the Cayugan Group, beginning with the Niagara (McKenzie) and followed by the Rondout with its basal Bloomsburg Sandstone member, and later the Bossardville thin-bedded limestones and shales above were deposited. The Niagara (McKenzie) has a number of horizons with abundant marine fossils, which represent but few species. As a whole the Niagara shows evidence of shallow and restricted sea conditions. With the Keyser member of the overlying Helderberg we have in Hardy County the beginning of the next marine invasion, which marks the Devonian.

From the above it can be seen that the Silurian sediments show a rather perfect cycle of sea inundation and retreat,

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[1]Report, Maryland Geological Survey, 1923.

[2]David B. Reger, Report Mineral and Grant Counties, W. Va. Geological Survey, 1924.

System	Series	Division	W. Va.	Pa.-Md.	N. Y.
Devonian	Helderbergian		Helderberg	Helderberg	Helderberg
SILURIAN	Cayugan	Upper	Bossardville Rondout Bloomsburg	{ Bossardville { Tonoloway Wills Creek Bloomsburg	Manlius Cobleskill Bertie
		Lower	Niagara	McKenzie	Salina
	Niagaran	Lockport			
		Clinton	Clinton	Clinton	Rochester } Clinton Clinton }
	Medinan	Albion	White Medina	Tuscarora	Albion
		Richmondian	Red Medina Gray Medina	Juniata	Queenston
Ordovician	Cincinnatian		Martinsburg		

marked, as most such geological movements are, by times of hesitancy, minor reversal, and separation of sea basins.

The subdivisions of the Silurian, as used in this publication, with their equivalents as used by other Surveys, are given on page 239.

GRAY MEDINA.

General Character and Extent.—The gray sandstone of the Medina group outcrops in the three anticlinal areas in the eastern part of the county in which the Martinsburg Shales are exposed. In these areas the drift from the higher White Medina Sandstone largely conceals the rocks of this type, so that its relation to the underlying Martinsburg and to the overlying Red Medina is difficult to determine. The Gray Medina is well developed throughout the portion of the county in which it occurs. In the section through Cove Mountain, 2 miles southeast of Lost City, the sandstone seems to have a thickness of about 400 feet. Here also it is rather variable in character. At base it is fine grained and a dark gray in color, while the top 150 feet is a much coarser and lighter gray sandstone, with many small buff to yellow spots through the sandstone, which mark small areas of oxide of iron stain and cement, usually not over 1/4 inch in diameter.

Topography.—The Gray Medina is more resistant to weathering than the red sandstones and shales above it, but is less resistant, as a whole, than the White Medina, which is the chief ridge-former of the northeastern part of the county. On account of its relatively greater resistance than the Red Medina or the Martinsburg, it usually forms a bench on the slopes of the hills which lead down from the White Medina crests to the Martinsburg valleys.

Contacts.—So far as known the Gray Medina Sandstone is unfossiliferous in Hardy County. This fact, taken in connection with the fact that the overlying red sandstones and shales are also unfossiliferous, and that beds of gray sandstone similar in character to the Gray Medina are known to occur in the Red Medina, leads one to the conclusion that the Red and the Gray Medinas belong to the same Period and further that they differ but slightly in their phase of sedimentation.

Subdivisions.—Although the Gray Medina is somewhat different in lithological characteristics in the upper and lower portions, these differences are not sufficiently constant to warrant subdivision.

Economic Aspects.—Like the White Medina, these sandstones are of no practical economic value, unless it be for crushed stone for bottom layer in macadam roads or for concrete material.

RED MEDINA (JUNIATA).

General Character.—The Red Medina is composed of brick-red shales and red to greenish-brown to gray sandstones. The upper portion of the formation is usually more shaly than the lower portion. The sandstones are frequently cross-bedded and sometimes micaceous and in some localities their coloring is so strong with iron oxide as to make it difficult to distinguish them from the red sandstones of the Clinton Red Shale. Partings and thin shale beds are common in the lower sandstone phase of the Red Medina.

These red shales and sandstones lying beneath the White Medina have in recent years been called Juniata by the United States Geological Survey from the outcrop of these rocks on the Juniata River in central Pennsylvania.

Thickness.—In the Adams Run Anticline the Red Medina reaches a thickness of 550 feet. In the Hanging Rock section the upper 150 feet only of the formation is exposed in the center of the arch which is here cut by Lost River.

Areal Extent.—The outcrop of the Red Medina is confined to the three anticlinal areas along the eastern border of the county and to the cut through the Hanging Rock Anticline, along the Wardensville-Moorefield highway. None of the structures in the western part of the county are sufficiently eroded to bring the Red Medina to the surface, with the exception of the Elkhorn Mountain Anticline, in which the Red Medina has a small area of outcrop on the crest of the structure, but this is just over the line from Hardy County in Grant County.

Due to the rather shaly character of much of the formation, the Red Medina is not as resistant to the weathering agents as the much more quartzitic White Medina Sandstone overlying it, and on this account, wherever the two are exposed with considerable dip, the White Medina invariably forms the crest of the hill and the Red Medina the sloping portion of the elevation, and in consequence it is usually well covered by drift from the overlying White Medina (Tuscarora). In the three anticlines in the eastern part of the county, in which the Red Medina is best exposed, the erosion has continued down through the Gray Medina and well intc the Martinsburg Shale of the Ordovician, thus leaving the Red Medina well up on the slope of the hill. This is the usual condition where deep erosion has taken place and as a result exposures of this formation are difficult to find in much of the area of their outcrop.

Contacts.—At no known locality in the county is there a decided structural break between the White and the Red Medina, though the change in coloring is indicative of a rather marked change in the nature of the sedimentation. The white sands of the White Medina must have been deposited under such conditions as would preclude the deposition of colloidal clay material with the sand grains and thus largely remove the probability of their becoming colored through stain. Such conditions would best be brought about along the shore-line or in a depth of water where there is considerable movement and little chance for the finer suspensoids to settle. In the case of the Red Medina, it would seem that these suspensoids settle to a considerable extent in the original sediments and thus form a mordant for the iron stains so common in these rocks. For this condition the deposition of the sediments on land slopes or shallow basins or deltas or estuaries away from the active wave and current action would be necessary. It would seem reasonable that during the deposition of the Red Medina the lands in the area of the present distribution of the Red Medina were largely above the ocean but close to sea-level and that the transgression of the ocean brought about the deposition of the clean white sands of the White Medina. This change from the Red to the White is transitional in places so that it is not easy to draw the line exactly between the two formations. This in itself is another strong argument for maintaining the Red Medina in the same period as the White Medina (Tuscarora). The White Medina also is largely transitional into the Clinton in many localities.

Fossils.—The author has not been able to find fossils in the exposures of the Red Medina in Hardy County so that it is not possible to subdivide the rocks except on lithological data nor is it practical to use this latter method, since the sections differ very much in short distances in the same area.

Economic Aspects.—The Red Medina Sandstones and Shales are both too impure to be of value either for building stones or for shales in the manufacture of brick.

WHITE MEDINA (TUSCARORA) (ALBION) SANDSTONE.

General Character.—The White Medina of the New York and Pennsylvania Surveys has been given the name of Tuscarora from its outcrop in the Tuscarora Mountains in Pennsylvania.[2] The name Albion has been given to the White Medina of New York by E. M. Kindle.[3] This white sandstone of New York, Pennsylvania, Maryland, and West Vir-

[2]U. S. Geological Survey, Folio No. 32, 1896.
[3]U. S. Geological Survey, Folio No. 190, 1913.

ginia is unquestionably of the same age, since it is below the Clinton in each area and above the Red Medina into which it has a gradational characteristic in a number of places.

The White Medina is for the most part a fine-grained, compact, white sandstone varying from thin- to rather thick-bedded, and frequently with a siliceous cement, so that the rock is quartzitic in character and very resistant to weathering. In places, the sandstone toward the top of the formation is thin-bedded with shale partings. In places also the upper portion of the formation has the sandstones of rather coarse grain which are not so tightly cemented as in many of the lower beds, and as a result, such outcrops, where long exposed to weathering, break down into loose sands. For the most part the areas of outcrop of the White Medina are very rocky with scant soil and are usually forested.

Thickness.—The White Medina in the Lost City Section is 400 feet thick, (See page 337), in the McCauley Section 256 feet thick, (See page 338). In the Elkhorn Mountain region its thickness is not far from 300 feet, and in Grant County, to the west of Hardy, its thickness varies from 175 feet to 317 feet.

Topography.—On account of the quartzitic character of the White Medina and its massive bedding, it is the most resistant rock to weathering of any exposed in the county. It is everywhere, in its area of outcrop, the chief ridge-forming rock and the great blocks of sandstone, which frequently form the crest of the hills, break away from the ledges along the joint-planes and work by gravity down the steep hill slopes to the valley, frequently concealing the less-resistant sandstones and shales of the underlying formations.

Areal Extent.—The chief areas of outcrop of the White Medina are in the three large anticlines along the eastern border of the county. Besides the exposures here, there is a small area in Hanging Rock Anticline and another in the south-central portion of the county in the Elkhorn Mountain Anticline. With the exception of this latter area, all exposures are to the east of the Lost City-Lost River Valley.

In this eastern belt most of the higher ridges, such as Cove, North, Long, and Paddy Mountains and Sugar Knob, are held up by White Medina Sandstone to elevations usually approaching and frequently exceeding 3000 feet, while the elevations in the Martinsburg Shale valleys enclosed by the outcrops of this sandstone are frequently about 1700 feet.

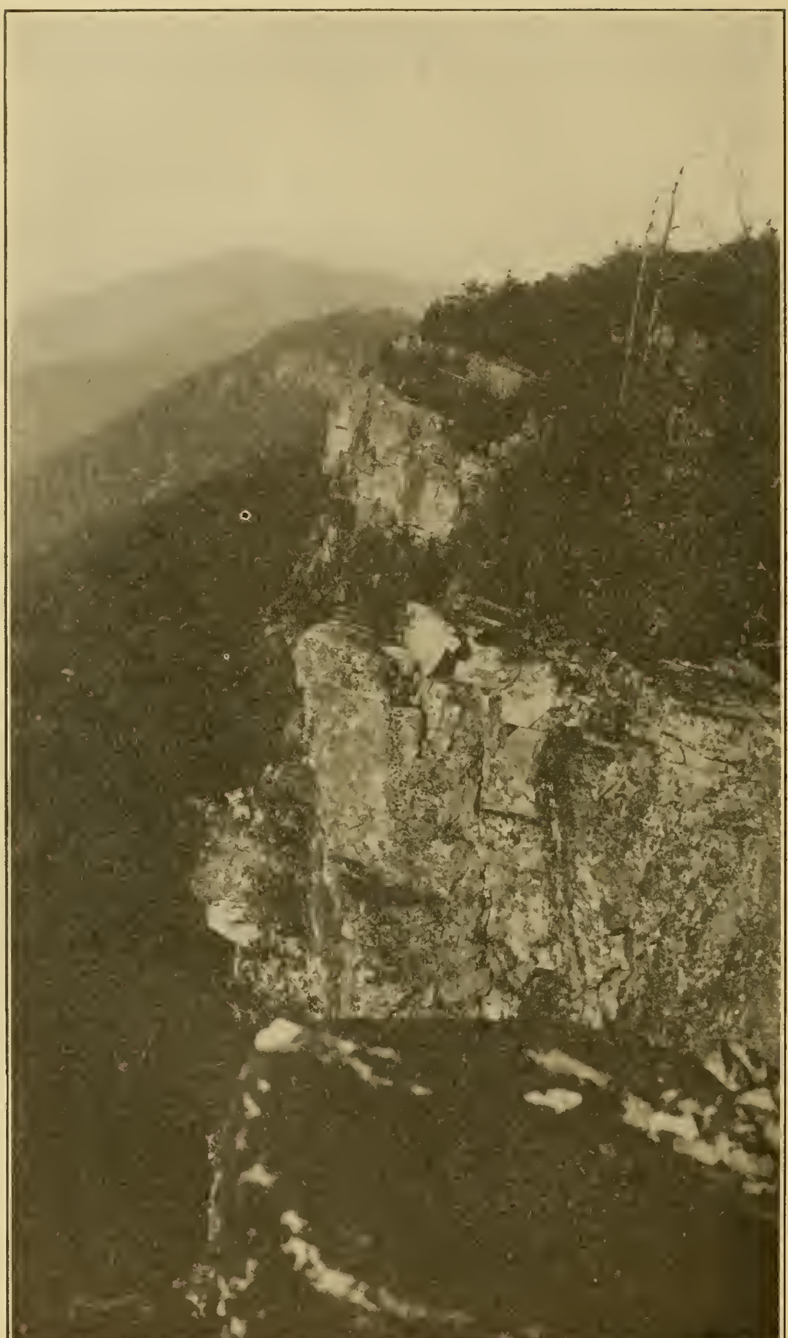


PLATE LIII.—View of White Medina Sandstone cliffs northward from Elkhorn Rock on Elkhorn Mountain.

PLATE LIV.—"Old Man of the Mountains." View of White Medina Sandstone at Elkhorn Rock. Cliff is about 150 feet high at this point.

PLATE LV.—View from Elkhorn Rock looking northwestward toward Mitchell Run and Durgon Creek, the center foreground of the picture being about on the Hardy-Grant County line.

Contacts.—There is in some localities gradation of the White Medina into the Clinton. Along this line the white quartzitic sandstones become thinner and begin to alternate with thin arenaceous shales.

Fossils.—These thinner sandstones frequently carry an abundance of **Arthrophycus alleghaniensis** on the underside of the sandstone and top of the shale and in addition there are, in some localities, rod-like markings which extend into the white sandstone layers perpendicular to the bedding and frequently as much as one foot or more in length. This **Scolithus verticalis** or worm-boring is common in some beds. In the shales which are intercalated with the quartzitic sandstones there are occasional markings of what seems to be sea-weed and occasionally a **Camarotoechia neglecta,** a form which occurs abundantly throughout the Clinton. This fossiliferous portion is placed by some in the Clinton. Toward the base, the White Medina (Tuscarora) grades, by alternating red and white sandstone beds, into the Red Medina or Juniata. The basal line has been drawn where the rock is predominatingly red.

Subdivisions.—It does not seem practical to attempt subdivision of the White Medina as the relatively scanty fauna is confined to the top portion and the lithological characteristics are nearly uniform throughout. In the opinion of the writer there has been too strong a tendency to draw the line between the White Medina and the Clinton a little too high, in areas where the transition is better marked. The thinner quartzitic sandstones and interbedded shales which in some places have yielded **Camarotoechia neglecta** and also **Buthotrephis** sp. should be included in the Clinton. In the McCauley Section, the bottom 15 feet of the Clinton as described on page 250, have sandstones which might well be classed with the Medina, but the interbedded shales with their Clinton characteristics have caused the line to be placed at the top of the massive sandstone.

Economic Aspects.—From an economic standpoint the White Medina is of practically no value since its quartzitic character makes it too expensive to quarry for a building stone, although its physical qualities and color make it well suited for such. Locally the upper beds are sufficiently loose grained to allow weathering into glass-sand but the thickness of these bads is insufficient and their occurrences too irregular and inaccessible to make them of value. The white quartzitic sandstones are suited for ganister, but their location is too far from market to make quarrying for this purpose profitable. Along the lines of highway these sandstones could be utilized as crushed stone for road building and cement work. In Ohio the White Medina Sandstones are oil and gas bearing but in this portion of West Virginia there is too much folding for workable deposits to be found at present in these sandstones, granting that they were originally petroliferous.

A sample of the White Medina Sandstone exposed along Waites Run, just above road, 1.5 miles south of Furnace, was taken by Tucker (Sample No. 18-T, Laboratory No. 2952) for analysis by B. B. Kaplan, Chemist of the Survey, who reports the following:

	Per cent.
Silica (SiO_2)	97.34
Ferric Iron (Fe_2O_3)	0.86
Alumina (Al_2O_3)	0.94
Lime (CaO)	0.36
Loss of Ignition	0.64
Total	100.14

The Medina at this point is overturned and dips east 65°, with strike N. 30° E.

CLINTON.

General Character.—The Clinton is largely of arenaceous and argillaceous character. The shales are usually greenish to gray in color and have thin beds of buff-weathering sandstones. Toward the base the sandstones increase in number and thickness and are more compact and greenish to gray in color, like the shales with which they are associated. In nearly all sections there are two well-defined heavy sandstone horizons, one a very ferruginous sandstone which varies considerably in its position from above the middle of the Clinton deposit to well toward the base, depending upon the completeness of the record of the lower Clinton rocks in the section in question. Toward the top of the Clinton there is usually present a well-developed quartzitic sandstone (Keefer Sandstone) with which is associated, locally, thin beds of iron ore. It seems to be true that the iron ore is more apt to be developed in this horizon in localities where the upper sandstone is more shaly. The portion of the Clinton above the Keefer is usually concealed and appears to be of argillaceous shale character, and, where present, is not thick. The portion of the section between the two sandstones is usually made up of a greenish shale, with thin bands of calcareous sandstone, which, on weathering, become soft and buff-colored and are more apt to be fossiliferous than other portions of the Clinton.

The Clinton of Hardy County is in general much like the Clinton along the Potomac, farther northeast. The chief dif-

PLATE LVI.—An Iron Ore Prospect. One of the several openings in the Clinton Ore in and around Furnace, 4 miles south of Wardensville. Photo (taken October 6, 1921) by courtesy of W. H. Wyand, Hagerstown, Md.

ference is in the less fossiliferous character of the beds, the less well-developed Rochester phase, and the more changeable character of the lower part of the Rose Hill, or Lower Clinton, portion of the Clinton Group.

Thickness.—The thickness of the Clinton, as exposed, in the eastern part of Hardy County, is about 400 feet. The best section studied is that along the Wardensville-Moorefield road, beginning at the post-office at McCauley and running toward the east for about one-fourth of a mile. The section here is as follows:

Section of Clinton, along Wardensville-Moorefield road for about 1 4 mile east from McCauley.

	Feet.
Niagara (McKenzie).	
Clinton	
Concealed	35
Massive, white to gray, quartzitic sandstone glistening in sun, from the surface of small quartz crystals in many quartz druses (Keefer Sandstone)	30
Concealed, probably in part shale	4
Thin-bedded, quartzitic sandstone (lower bench of Keefer)	7
Thin-bedded, olive to gray, arenaceous argillaceous shale	20
Ovile to gray to buff, arenaceous and argillaceous shale with 1" to 3" green to gray sandstone layers, which are more calcareous and ferruginous toward the top and carry *Tentaculites minutus* and a few other fossils	40
Deep-red, ferruginous sandstone (Iron Sandstone)	12
Olive to gray, arenceous shale with few argillaceous sandstones in 1" to 3" bands	190
Like above, but more sandstone than shale, and sandstones, 1 foot or more thick	15
Olive to gray sandstone and shale, less sandstone than shale	12
Mostly hard, olive to gray sandstone	10
Olive to gray sandstone and shale, about equal parts	10
Like above, but more shale than sandstone	15
Mostly olive to gray sandstone in beds of more than 1 foot	5
Olive to gray shale	10
Concealed, probably mostly shale	56
Buff, quartzitic sandstone	1
Dark-gray to green, arenaceous shale and thin, wavy sandstone	10
Gray argillaceous sandstone	3
Gray arenaceous shale	1
Total	486

KEEFER SANDSTONE.

In the Elkhorn Mountain area along the trail between Bass P. O. and Durgon, where the arch has been cut by erosion, there are two good exposures of the Keefer Sandstone. The exposure on the more gently dipping eastern lim bshows about 11 feet of quartzitic, gray sandstone. The western limb has three feet of shaly sandstone above and nine feet of quartzitic sandstone below. Immediately above the 3-foot shaly sandstone layer is a shale with thin, rotten, buff-colored sandstones, packed with very poorly preserved fossils. From the shales 10 feet below the Keefer Sandstone a small collection shows **Calymene clintoni, Tentaculites minutus, Chonetes** sp., and **Orthoceras** sp.

Topography.—The Keefer Sandstone at or near the top of the Clinton and the Iron Sandstone below are both resistant to weathering and frequently form ridges. The shaly portion of the Clinton below the Iron Sandstone is quite variable in its composition as well as its thickness and is much more sandy than the shaly portion of the Clinton between the Iron Sandstone and the Keefer Sandstone. This upper shale member is usually a line of weakness in the Clinton outcrop, while the Keefer and the Iron Sandstones tend to form ridges.

Distribution.—With the exception of the Elkhorn Anticlinal area the exposure of Clinton is confined to the portion of the county east of the Lost River-Lost City Valley. The best and most accessible exposure is that about the White Medina outcrop in the Hanging Rock Anticline. A section of this outcrop at McCauley is given above. The most continuous exposure of the Clinton is in the eastern part of the county. Here it extends from the Rockingham, Virginia, County line, northeastwardly, along the western slope of Cove Mountain, the western slope of Long Mountain, and the western slope of North Mountain to the Hampshire County line, at a point about 0.3 mile northwest of the northeast corner of Hardy County. The total length of this continuous outcrop in the county is about 34 miles. In this course there are two loops, one where the strata swing eastward around the Adams Run Anticline and the other where the strata pass over the Anderson Ridge Anticline. Throughout the greater portion of this outcrop the rocks have a very steep dip and as the outcrop is usually topographically lower than that of the White Medina, there are but few localities where the rocks of Clinton age are not covered with drift from the more resistant sandstones.

Contacts.—The contact with the White Medina is, in places, seemingly transitional, but toward the southwestern part of the county and over the line in Pendleton County there is a decided erosional unconformity between them. This is best shown by the close approach of the Iron Sandstone to the White Medina.

The top contact of the Clinton is difficult to determine. It may be at the top of the Keefer Sandstone or more probably in the shale a little above it, as in the Maryland sections. In one locality a few poorly preserved fossils in a decomposed sandstone were found above the Keefer which suggested Rochester type but no positive identifications were made. As a rule the rock immediately above the Keefer is concealed.

Fossils.—The Clinton in Hardy County has few fossils. The most abundant fossils occur in the thin calcareous sandstone bands in the shale below the Keefer. There are a few fossils in the Iron Sandstone and a few scattered throughout. All are marine in type. The forms seen are: **Camarotoechia neglecta, Tentaculites minutus, Chonetes novascoticus, Calymene clintoni, Buthotrephis gracilis** var., **Orthoceras** sp., a number of species of ostracods and bryozoa. The fossils observed are typical Clinton forms.

Collections were made at fossil localities 32B, 45A, and 56, as follows:

Collection 32B.

On second-class road over Mill Creek Mountain, near forks of road and gate, 1.2 miles northwest of Glebe Station (Sector P. O.), Hampshire County.

Echinodermata
- Crinoid stem sp.

Molluscoidea
- **Brachiopoda**
  - Uncinulus sp.
  - Whitfieldella sp.

Mollusca
- **Pteropoda**
  - Tentaculites minutus Hall
  - Tentaculites novascoticus Hall.

Collection 45A.

1.5 miles northwest of Brake from old ore pit by road.

Molluscoidea
- **Brachiopoda**
  - Coelospira sp.
  - Meristina sp.
  - Whitfieldella marylandica Prouty
  - Whitfieldella cf. minuta Hall

Mollusca
- **Pteropoda**
  - Tentaculites niagarensis Hall

Arthropoda
- Bonnemaia sp.

Collection 56.

Old iron ore prospect by stream on Grant County side of Grant-Hardy County line, 2.0 miles northwest of Brake.

Echinodermata
  Crinoid stem sp.
Molluscoidea
  Brachiopoda
    Camarotoechia neglecta Hall
    Spirifer cf. radiatus Hall
Mollusca
  Pteropoda
    Conularia sp.
    Tentaculites minutus Hall
Arthropoda
  Ostracod sp.

Subdivisions.—The Clinton of Hardy County is much less fossiliferous than that farther to the northeast in Maryland, and it is therefore much more difficult to distinguish the horizons here than it is there. Of the fossil horizons the Calymene clintoni zone, which lies just below the Keefer Sandstone, is the best marked. There are usually many Tentaculites minutus in this horizon and in the Elkhorn Mountain area two specimens of Calymene clintoni were found about ten feet below the heavy quartzitic Keefer Sandstone. The portion of the section above the Keefer is seldom seen in any of the exposures, as it is very easily eroded and concealed. The shale which occurs in this horizon is almost without fossils, so that the Rochester-McKenzie line is difficult to draw and for field practice the line is taken at the top of the Keefer Sandstone.

The formation is divisible into five parts: (1) the shales and sandstone portion, extremely variable in thickness, between the Iron Sandstone and the White Medina, (2) the Iron Sandstone, sometimes rather inconspicuous as in the McCauley section, (3) the shale with calcareous and fossiliferous sandstone beds between the Iron Sandstone and the Keefer, (4) the Keefer Sandstone, and (5) the upper shale, where present, of probable Rochester age.

Economic Aspects.—In the Elkhorn Mountain Anticline area there are several old openings on the Clinton iron ore. These are on the western limb of the fold and some of the openings are over the line in Grant County. The ore in this district is variable in its thickness. The thickest bed of ore measured in any of the old prospect pits is 38 inches. At other localities in this district ore from 3 to 10 inches in thickness is common. It would seem from the above that while there may be locally sufficient ore to encourage development, the variability of the bed and the distance from market make profitable development of these red ores entirely out of the question.

The Iron Sandstone beds are frequently blocky and the stone is very resistant to weathering, so that its outcrop is frequently a minor ridge. This resistance to weathering, in addition to its red to brown color, gives the sandstone value as a building stone, for which purpose it might be utilized, if the deposits occurred close to a large city.

NIAGARA (McKENZIE).

General Character and Thickness.—The rocks of this age are largely shales with thin lenses and beds of limestone and calcareous sandstone. Near the top, in certain localities, the thin limestone lenses carry numerous specimens of Camarotoechia andrewsi. In the lower portion of the Niagara the calcareous lenses and thin beds are more apt to be arenaceous and less fossiliferous. Taken as a whole the rocks of this age are much more shaly and sandy than they are in Maryland and in the West Virginia area to the west of Hardy County.

A common thickness for the rocks of this age is 250 feet. The upper limit of the Niagara is drawn at the base of the Bloomsburg Red Sandstone, which through this section is about 40 feet thick.

One of the best sections of the Niagara in the county occurs along the Moorefield-Wardensville road just east of McCauley P. O. The section here is as follows:

Section of the Niagara (McKenzie) just east of McCauley, on Moorefield-Wardensville Road.

	Feet.
Buff-weathering arenaceous and argillaceous shale and thin-bedded argillaceous and calcareous sandstone in 1" to 3" layers	210
Thin-bedded, hard, buff-weathering sandstone and arenaceous, buff shale, mostly sandstone	4
Dark, argillaceous and arenaceous shale, weathers buff to gray	15
Concealed, probably shale and with lower limit of formation in this horizon	35
Keefer Sandstone	--

In the Elkhorn Mountain area west of Bass, the Niagara Formation, on the west limb of the fold, measured 204 feet between the top of the Keefer and the bottom of the Bloomsburg. There is practically no exposure of the Niagara along the trail between these limits but near the area of the anticline, a little farther south, the upper shales and their thin and very fossiliferous limestone layers outcrop near the crest of the hill. In places the thin limestone slabs occur in considerable number on the surface. The chief fossil in these limestone slabs is Camarotoechia andrewsi, which in the Maryland section occurs in great profusion in the upper third of the Niagara.

Although the Niagara (McKenzie) rocks of Hardy County are less calcareous than those of Maryland and the counties of West Virginia to the west of Hardy, the time represented by their deposition seems to be about the same, judging from the fossil horizons which are to be found in the Hardy County area.

Topography.—The Niagara shale is much less resistant to weathering than the Bloomsburg Sandstone above or the Keefer Sandstone below and as a result is usually valley-forming and seldom has good exposures.

Distribution.—The Niagara outcrops in the county over a wider area than does the Clinton, on account of the fact that it is brought up in a number of places in the western part of the county along the axes of the anticlines where the Clinton does not show.

In the eastern part of the county the Niagara follows the same outcrop as the Clinton through Cove, Long, and North Mountains.

In the Hanging Rock Section it forms a large loop about the Clinton outcrop in the main anticline and extends southward from the Hampshire County line a distance of 11 miles. In the northern portion of this exposure the outcrop is much wider than in the southern, as at the northern end of the loop, where the anticline is crossed, the structure has much less plunge than at the southern end of the loop. There is also in this area a small parallel structure on the east side of the main anticline and about 0.5 mile distant from it in which the Niagara is brought up along the axis in a belt about one-eighth of a mile wide and about 10.5 miles long.

In the Elkhorn Mountain area the Niagara loops about the Clinton outcrop with the narrow exposure due to the fact that here the Bloomsburg Sandstone forms a ridge about the outcrop of the Niagara and Clinton shale area, which occupies a depression. This give a dip of bed opposite in direction to the slope of the surface. The length of the loop north of Elkhorn Rock is 3 miles. To the southwest from Elkhorn Rock the western portion of the loop is in Grant County but on the southeast side the loop has an outcrop length of 2 miles in Hardy County.

In the Patterson Creek Mountain area there are two small outcrops of the Niagara, one of about 0.5-mile cross-section, along the Moorefield-Williamsport road, and the other a still smaller outcrop about one mile to the northeast of where the above road crosses the axis of the anticline.

Contacts.—The lower limit of the Niagara is difficult to determine both because of the scarcity of fossils in this horizon and because there are few localities where the rocks immediately above the Keefer Sandstone are well exposed. It is very probable that the Rochester is to be found for a few feet above the Keefer Sandstone in a number of places, but from a practical mapping standpoint the top of the Keefer has been chosen as the base of the Niagara. The upper contact with the Bloomsburg Red Sandstone is relatively sharp in Hardy County. The gray shales and thin-bedded limestone with local abundant marine life give place to the shallow-water or land deposits and Bloomsburg Red Sandstone with practically no fossils. While the change is marked, there is little evidence of any considerable time gap at this contact.

Fossils.—No collections were made from the Niagara, but field study shows the presence of a few species characteristic of the Niagara (McKenzie) of Maryland. Camaratoechia andrewsi is abundant in some limestone lenses in the upper third of the formation. Hormotoma sp. occurs a little lower in the formation in the compact, dark-gray limestone. Ostracods of several species occur, but are not as common as in the areas where limestone is more abundant. The formation seems to represent the same time as the McKenzie of Maryland. The following fossils have been identified from the Niagara: Camarotoechia andrewsi, Hormotoma hopkinsi, Drepanella sp., Leperditia sp., Eukloedenella sp., Cuneamya sp. Collections were made at fossil localities 32A, 45, and 47, as follows:

Collection 32A.

On second-class road over Mill Creek Mountain, 1.1 miles northwest of Glebe Station (Sector P. O.), Hampshire County.

Mollusca
- **Pelecypoda**
  - Cuneamya sp.

Arthropoda
- Leperditia sp.
- Drepanella sp.
- Drepanellina sp.
- Eukloedenella sp.

Collection 45.

Upper Niagara. 1.5 miles northwest of Bass.

Molluscoidea
- **Brachiopoda**
  - Camarotoechia andrewsi Prouty.

Arthropoda
- Ostracod sp.

Collection 47.

Top. About 300 feet northwest of Locality 46, 0.3 mile northwest of Bass.

Molluscoidea
  Brachiopoda
    Camarotoechia andrewsi Prouty.

Subdivisions.—Toward the top of the Niagara is the well-defined Camarotoechia andrewsi faunal zone, and below this, in the less crystalline limestone beds, occurs the Hormotoma sp. characteristic of the Hormotoma zone in the Maryland area. The correlation of the bottom portion is not so apparent, as there are less fossils in the Hardy County area than elsewhere to the north and west of this district.

Economic Aspects.—Some of the arenaceous shales are excellent for surfacing light-traffic roads as they have a natural mixture of sand and clay with some lime to aid as a cementing agent. Where the outcrop is on level land, there is usually a fairly productive residual soil.

BLOOMSBURG RED SHALE AND SANDSTONE.

General Character.—In most of Hardy County the Bloomsburg is a sandstone, but toward the western part of the county the upper portion becomes a shaly sandstone or an arenaceous shale. In all exposures, this formation is deeply colored by oxide of iron. The most common color is a brownish-red; but locally it is more of a buff and in a few places it has green coloring in part. The average thickness is from 30 to 40 feet. Locally it gets to be 60 feet or more. It is very probable that this sandstone was put down in a lagoon in which the water was sufficiently saline to preclude the development of sea life, as the sandstone is practically barren of fossils. There must also have been frequent periods of exposure to the atmosphere to account for the deep oxide-of-iron color in the formation and for the sun-cracked condition of some of the beds.

Topography.—The Bloomsburg is everywhere more resistant to weathering than the rocks with which it is in contact, and, on this account, it is a ridge-former. These ridges do not get to be very high, because of the jointed character of the sandstone which allows it to break off in blocks as it becomes undermined by the weathering of the underlying shales and limestones of the Niagara.

Distribution.—In its distribution the Bloomsburg is practically the same as the Niagara. It follows the same outcrop belt through Cove, Long, and North Mountains and about the Hanging Rock Anticline. In this latter area it makes the loop about the older rocks in the main anticline and also is brought up in the small parallel anticline that occurs on the east flank of the main structure, so that we have on the east limb of this anticline and the eastern slope of Pine Ridge three parallel outcrops of this sandstone extending from about three miles south of Hanging Rock to the Hampshire County line. In the Elkhorn Mountain area, the Bloomsburg makes an unusually large outcrop, due to the fact that the eastern slope of the mountain is about the same as that of the sandstone. In places the sandstones have a width of outcrop on the hillside, in the direction of dip, of more than 1500 feet. Along the axis of the anticline, at the location of these sandstones, there are a number of outliers of sandstone that have the appearance of fortresses, with their nearly vertical walls and flat tops. These remnants rest upon the Niagara shales and thin interbedded limestones, which are easily eroded and which have made a very unstable base for the sandstone. In the Patterson Creek Mountain Anticline the Bloomsburg occurs in two small loops of about three-fourths mile each. One of these occurs on the Moorefield-Williamsport road and the other outcrops about one-half mile to the north of this road. Both of these areas are just over the line in Grant County.

Contacts.—The contact of the Niagara with the Bloomsburg is comparatively sharp. We have here the change from a marine condition, with local abundant life, to a near shore and probable saline lagoon condition, where practically no life was sustained in the waters and where there must have been frequent elevation of the lagoon to allow oxidation to take place in the sediments. The time gap here represented is difficult to determine. We do not yet know with certainty the exact age of the so-called Niagara or McKenzie Formation, and the fossil content of the Bloomsburg is very meager and of slight value for correlation purposes. The upper contact of the Bloomsburg is not as sharp as the lower one and the time represented by the change from the red sandstones to the gray shales and sandstones is seemingly not very much. In the eastern part of the county, it would seem from the section given of the Rondout, page 259, that the change was transitional through a lagoon to deeper water conditions.

Subdivisions.—For most of the area of Hardy County the Bloomsburg is of one type, a brownish-red sandstone, but for some of the western outcrops there is a shaly upper portion. Where the shaly portion is conspicuous, in Grant County, Mr. Reger has called the sandstone portion the **Williamsport Sandstone,** from its outcrop near Williamsport, Grant County.

Economic Consideration.—The Bloomsburg Sandstone in many places is of the right color to be used with pleasing effect as a building stone. If its outcrop were near a large city, quarries would doubtless be opened in it for this purpose. Under the conditions of its outcrop in Hardy County, it has no important economic value.

RONDOUT WATERLIME (WILLS CREEK).

General Character.—The term Rondout Waterlime is used here to mean the shales, limestones, and sandstones which lie between the thin-bedded or ribbony limestones of the Bossardville and the top of the brownish-red sandstone, the Bloomsburg. The name as here employed differs from the Wills Creek in that it does not include the heavy sandstone, the Bloomsburg, at the base. In the western part of Hardy County the Rondout is more highly calcareous than in the eastern. The limestone in the upper portion of the Rondout, in the western part of the county, is more massive and darker colored and more apt to break into rectangular blocks than the overlying Bossardville Limestone, which usually is more ribbony and lighter colored. In the eastern part of Hardy County the Rondout is largely a shale. In the upper part it is usually a gray to buff-weathering, calcareous shale, with thin argillaceous limestones. Toward the base the Rondout becomes much more arenaceous, the limestone beds largely disappear, and the sandstones become important.

Thickness.—In the western part of the county the Rondout is about 320 feet thick and in the eastern part of the county it is about 420 feet.

A section of the Rondout exposed along the Moorefield-Wardensville road just east of McCauley is as follows:

McCauley Section, Rondout Waterlime.

Bossardville.
Rondout Waterlime.

	Feet.	Inches.
Concealed, probably mostly shale	83	0
Buff to gray-weathering calcareous shale and argillaceous, thin limestone	220	0
Calcareous sandstone	0	8
Dark-gray, thin-bedded shale	1	4
Arenaceous and calcareous shale	14	0
Argillaceous and calcareous sandstone	3	0
Thin-bedded, dark. arenaceous shale	6	0
Buff-weathering, calcareous, and argillaceous sandstone	3	0
Thin, dark-gray, arenaceous shale	10	0
Coarse, gray sandstone (spring here)	3	0
Coarse, buff-weathering sandstone	6	0
Thin, dark shale	4	0

	Feet.	Inches.
Buff-weathering shaly sandstone	4	0
Thin, buff-weathering shale	3	0
Sandstone	1	0
Shale	10	0
Shaly sandstone	3	0
Dark-gray shaly limestone	10	0
Dark-gray, compact, ribbony limestone, like Bossardville, with conchoidal fracture	3	0
Shale	9	0
Dark-gray limestone, like first limestone above	1	0
Thin-bedded, dark-gray, calcareous, and arenaceous shale	25	0
Heavy-bedded, gray sandstone	1	0
Very dark-gray, very thin-bedded, calcareous shale, with peculiar markings which may represent worm borings or possibly clay-balls	4	0
Sandstone with many clay-balls	1	0
Black arenaceous shale	4	0
Gray, thin-bedded, arenaceous shale, with sun-cracks	25	0
Total	465	0

Bloomsburg Red Sandstone.

Topography.—The Rondout is largely a shale, with thin beds of limestone or sandstone. On this account it is easily weathered and usually forms a valley. The Bloomsburg Red Sandstone below, is, on the other hand, resistant and ridge forming, and as a rule, the overlying Bossardville Limestone and Shale are more resistant than the Rondout. In the western part of the county the weakest portion of the Rondout is the central portion and in the eastern part of the county the upper portion. Plate LIX shows a valley developed in the Rondout.

Distribution.—The rocks of this age have an outcrop similar to that of the Clinton along Cove Mountain, Long Mountain, and North Mountain, on the west side of the three anticlines which form the eastern boundary of the county.

In the Hanging Rock Anticline the Rondout outcrops as a single belt on the west side but as double parallel belts on the east side, because of a minor fold which brings up the Niagara.

In the Elkhorn Mountain area there is a wide exposure of the Rondout on the east side of the anticline, where the dip of the rocks and the inclination of the surface are nearly alike. In this district the erosion is not sufficiently deep to expose the Rondout in the numerous minor folds which occur on the east limb of the anticline, as is the case with the Bossardville.

In the Patterson Creek Mountain Anticline there are three oval- or elliptical-shaped areas of outcrop of the Rondout. The one to the northeast is 3.25 miles long and 1 mile wide. The middle one is 1.25 miles long and 0.75 mile wide. The third area is on the mountain toward Petersburg. This area is 3.25 miles long and 0.8 mile wide. These three areas are about half in Hardy County and half in Grant County.

Contacts.—The contact of the Rondout with the Bossardville above is not clearly marked and it is probable that the line is not always drawn at the same horizon in different parts of the county. It has been the custom to place the thin-bedded, ribbony limestones, which form flags that cover the surface of the slopes on which they outcrop, in the Bossardville. The Rondout Limestone is usually darker gray and not ribbony and the weathered product is less buff-colored than that from the overlying limestones and shales. There are places in the Rondout, as in the section above given, where ribbony limestones occur similar to those in the typical Bossardville. The fact that the top portion of the Rondout becomes much more shaly toward the east makes the exact placing of the line difficult. In the Patterson Creek Mountain Anticlinal area, near Round Knob, the line between the Bossardville and the Rondout is drawn at the base of a buff-weathering sandstone which immediately underlies the thin-bedded ribbony limestone of the Bossardville. The section is here given:

	Feet.
Bossardville	
Thin-bedded limestone	10
Shaly limestone	2
Thin, laminated or ribbony limestone	4
Calcareous sandstone weathering yellow	5
Rondout	
Gray shales with limestone beds and lenses, in places arenaceous	25

The contact between the Rondout and the Bloomsburg is usually easier to draw, but there occur in some places pink to green to buff, arenaceous shales above the sandstone, which seem to belong with it rather than with the gray sediments above. One such section is given by Reger in the Report on Mineral and Grant Counties:

	Feet.
Limestone, flaggy, dark (**Rondout**)	
Bloomsburg Red Shale.	
Green, fissile, sandy shale	25
Hard, compact, greenish-brown sandstone (Williamsport Sandstone)	10

In the section above given from the eastern portion of the county, just east of McCauley, there is an increase in the arenaceous character of the Rondout toward the bottom, but there is a sudden color change. The brownish-red beds are here confined entirely to the sandstone.

Fossils.—A small collection from the top of the Rondout west of Bass has yielded several fragments of Eurypterus sp. and a number of Leperditia cf. elongata. Near the top of the Rondout in Thrasher Spring School section, Camarotoechia litchfieldensis occurs in considerable abundance. Spirifer vanuxemi, so common in the Wills Creek beds of Maryland, has not been observed in the Hardy County Rondout deposits. Species of Leperditia occur sparingly throughout the formation.

The following forms have been identified in Hardy County: Leperditia elongata, Camarotoechia litchfieldensis, Eurypterus sp., and Leperditia sp.

Collections were made at fossil localities 48 and 52, as follows:

Collection 48.

Along the same road as Localities 46 and 47, 0.25 mile northwest of Bass Post-Office.

Arthropoda

Eurypterus sp.
Leperditia cf. elongata Weller.

Collection 52.

Top. 100 feet below Stromatopora bed of Bossardville, 1.4 miles southwest of Williamsport.

Molluscoidea

Brachiopoda

Camarotoechia litchfieldensis Schuchert.

Subdivisions.—The Rondout is susceptible of four lithological divisions as exposed in the McCauley section. There is an upper calcareous shale and limestone division of about 270 feet. This is followed below by a shale and sandstone division of about 70 feet thickness. Below this occurs a calcareous horizon of about 20 feet and at the base another shale and sandstone division of about 60 feet thickness.

Economic Aspects.—There are a few places in the western part of the county where the limestones of the top portion of the Rondout are suitable for lime burning, but as there are other limestone horizons of greater thickness and higher content of calcium carbonate in proximity to the highways and railroad, the Rondout beds will never be used extensively if at all for this purpose.

Geological History.—During the formation of the Rondout the area of Hardy County must have been near the shore of a shallow sea in which there were numerous fluctuations of elevation close to and above sea-level. Many of the shaly sandstones as well as some of the impure limestones are suncracked. There are clay-balls in some of the sandstones. Conditions for life were exceedingly poor in these waters. Toward the western part of the county and especially toward the latter part of Rondout time slightly deeper sea conditions prevailed. There seem to be very slight erosional unconformities separating the Rondout from the Bossardville above and from the Bloomsburg below.

BOSSARDVILLE (TONOLOWAY).

General Account.—The Bossardville Formation in Hardy County is made up largely of limestone, which is thin-bedded and laminated. These thin beds of laminated limestone are often separated by thin shale partings, so that the limestone slabs weather out and frequently cover the surface of slopes in the area of the outcrop, making it easy to distinguish the formation at some distance. Besides these more typical limestones the Bossardville has an occasional bed of compact gray limestone, some calcareous shale, and usually one or more beds of calcareous and buff-weathering sandstone. There are certain beds which carry many fossils of a few species. This formation is less variable than the Rondout in its lithological characteristics. It was deposited in farther-from-shore conditions, where marine life was occasionally very abundant.

Thickness.—The thickness of the Bossardville is from about 300 to about 400 feet. A carefully measured section along the Wardensville-Moorefield road just east of McCauley gives a thickness of 333 feet. This section is as follows:

McCauley Section, Bossardville.

	Feet.
Helderberg	
Bossardville	
1. Thin-bedded, calcareous shale and thin beds of impure limestone, gray-weathering and ribbony --------	80
2 Massive, dark-gray, fine-grained, pure, conchoidal-fracturing limestone, with thin bands --------	1.5
3. Thin-bedded, shaly, laminated limestone, breaks in thin sheets ----------------------------------	90
4. Hard, metallic, dark-gray, pure, thin-bedded limestone having conchoidal fracture -------------------	5

		Feet.
5.	Thin, shaly, impure limestone	15
6.	Rather pure, dark-gray limestone, fossils, small Stromatopora, etc.	2
7.	Shaly limestone	10
8.	Shaly, calcareous and ferruginous sandstone and sandy, ferruginous, buff shale, mostly sandstone	12
9.	Rather pure, and more massive, gray limestone, carries some Stromatopora and other fossils, Hindella congregata, etc.	18
10.	Heavy-bedded, gray limestone, with many large Stromatopora, also Favosites, Bryozoa, and Hindella congregata	5
11.	Shaly, thin-bedded limestone	10
12.	Rather massive, argillaceous, gray limestone, some thin bands	25
13.	Massive gray limestone	28
14.	Thin-bedded impure limestone, thin black chert layers	2
15.	Concealed	8
16.	Thin-bedded, impure limestone, many fossils: Favosites, Bryozoa, Hindella congregata, etc.	8
17.	Largely concealed but probably mostly a calcareous sandstone, many buff-colored sandstone fragments in the soil	10
18.	Calcareous and argillaceous sandstone with Stromatopora	4

Rondout

Topographic Expression.—The outcrop of the Bossardville is usually low because it is a limestone and shale formation with the limestones as a rule thin-bedded and the shales more or less calcareous. The contact area between the Helderberg and the Bossardville shows a depression on the Bossardville side; as the basal Helderberg is made up of massive and relatively resistant limestone. In much of the area the upper Rondout is less resistant than the Bossardville and is less apt to be well exposed than the latter and slightly lower topographically.

Areal Extent.—The outcrop of the Bossardville follows the outcrop of the Middle Silurian formations along the western slopes of Cove, Long, and North Mountains.

In the Hanging Rock Anticline the Bossardville has a single outcrop on either side of the fold, which extends from Lost River to the Hampshire County line.

In the Elkhorn Mountain area there is a narrow outcrop of the Bossardville on the west slope of the structure, but on the east, the shallow dip of the formations and the repetition of the beds by minor folding make the area of outcrop much wider. At two localities, one about 1.25 miles and the other about 0.25 mile north of Bass, the formation has a width of outcrop of over one-half mile. In Dumpling Run, to the south of Ketterman School, the formation has an east-west

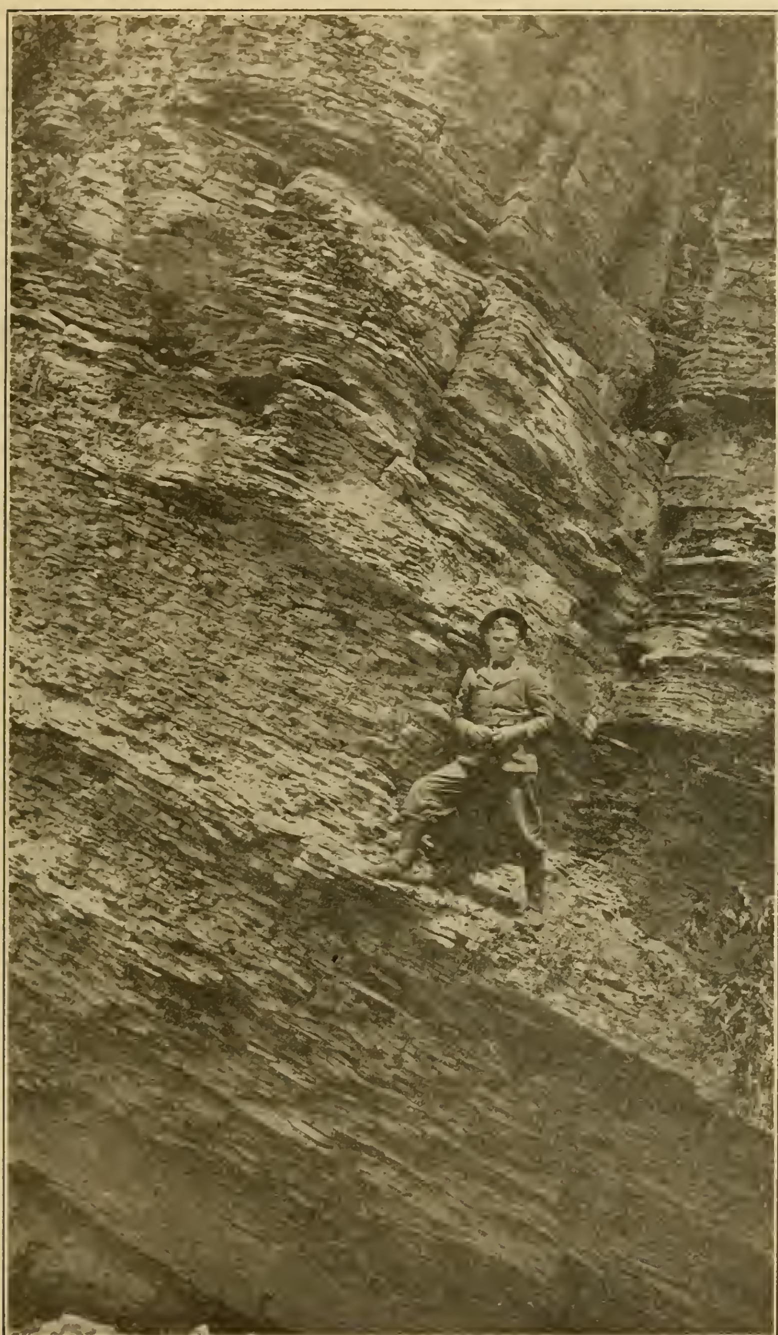


PLATE LVII.—A typical exposure of the Bossardville Limestone which has had a longer period of weathering than the outcrop seen in Plate LVIII. A number of the thin limestone layers in this exposure are largely made up of the fossil brachiopod Hindella congregata.

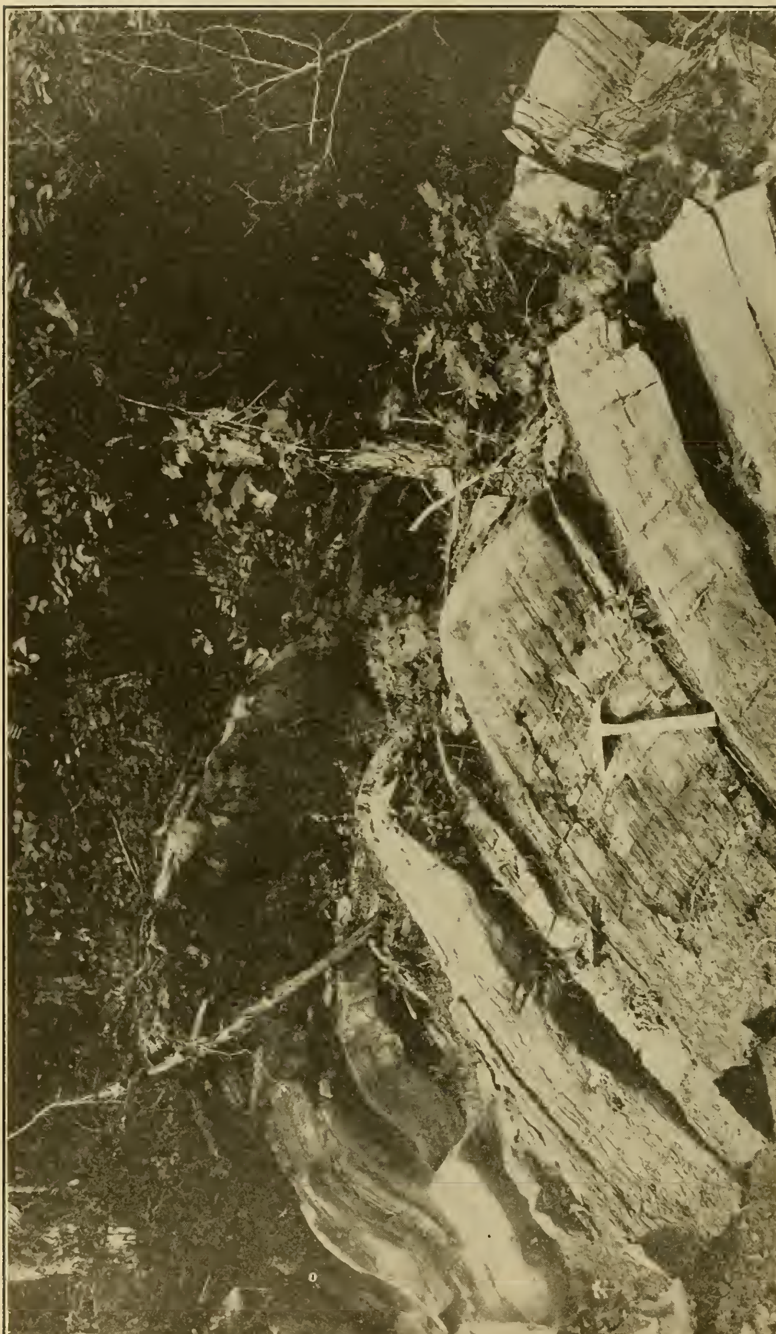


PLATE LVIII.—Bossardville Limestone at Ketterman School. (For description of plate, see page 270).

PLATE LIX.—Valley formed in the bottom Bossardville and the top Rondout. The Rondout calcareous shales and impure thin-bedded limestones are especially easy of erosion. 1½ miles west of Kessel.

Plate LX.—Stromatopora layer from the more massive limestone in the lower part of the Bossardville, Thrasher Spring School road, 2 miles southeast of Williamsport. The folded rule gives an idea of the size of the Stromatopora.

PLATE LXI.—On the Moorefield-Wardensville road, 2½ miles northeast of McCauley P. O., this cross had been carved on a ledge of Bossardville Limestone in situ. No doubt the work was done many years ago as it was necessary to retouch it with a pencil to bring it out in the photograph. (Photo. by Harris).

DESCRIPTION OF PLATE LVIII.—Typical outcrop of Bossardville thin-bedded, light-gray weathering limestone, exposed at Ketterman School, in the southwestern part of Hardy County, on Elkhorn Mountain Anticline. The color weathering bands in the limestone are frequently very thin, less than one-sixteenth of an inch, the color difference being due to the difference in the clay content in the alternate layers or laminae. This clay content is usually small in percentage. Outcrops of this type of limestone are frequently used for lime.

outcrop of about 1.5 miles. Along a small run about 1.5 miles north of Peru, a minor anticline brings up an outcrop of the Bossardville of about 0.5-mile cross-section. About 0.5 mile to the west of this anticline is another fold which exposes the Bossardville from a point about 1 mile south of Ketterman School to Hinkle School on the Pendleton County line. This exposure is 6 miles long and has a width of outcrop varying from 0.25 to 0.75 mile.

In the Patterson Creek Mountain area there is an almost continuous outcrop of the Bossardville from the Grant County line to the Hampshire County line. In this anticline there are three areas of cross-anticlinal folding and about each of these the Bossardville forms a rather wide loop. The northern of the three reaches within 1.5 miles of the Hampshire County line. The outcrop in this cross-fold unites with the outcrop in the next cross-fold to the southwest in a strip about 0.5 mile wide. In the structural saddle between this last cross-fold and the one to the southwest of it there is a break of about 0.25 mile in the outcrop of the Bossardville. This area is occupied by the Helderberg Limestone in Huckleberry Ridge, which owes its present elevation to the fact that the Oriskany Sandstone is still present in places or has but recently been removed from this locality by erosion. The Grant County-Hardy County line runs roughly along the crest of Patterson Creek Mountain from the Hardy-Grant County line to the Hardy-Hampshire County line, so that the three areas just referred to of expanded outcropping Bossardville are about half in Hardy County and half in Grant County. The area of outcrop of the Bossardville in Hardy County is considerably greater than that of any other Silurian formation. This is due to the present stage of the down-cutting or erosion of the rocks. A little later in the erosional history of the county, the rocks immediately underlying the Bossardville will have a larger area of outcrop than now, while the Bossardville areas will decrease in size in most places.

On the Broad Top (Stratford Ridge) Anticline there are two outcrops of Bossardville, one occupying the axial portion of the main structure and reaching south from the Hampshire County line about two miles, and the other a very narrow strip along the axis of a minor anticline about 0.3 mile west of the main anticline. These two strips of Bossardville are separated by a very narrow strip of Helderberg Limestone. The structure of this area is seen in Figure 12.

Contacts.—The upper contact of the Bossardville is usually rather clearly defined, since the bottom of the Helderberg is usually marked by a massive cobbly or nodular and highly fossiliferous limestone, which is more resistant to weathering than other limestones in this portion of the geological column.

The lower contact of the Bossardville is less readily distinguished than the upper contact, but in most parts of the county this line can be drawn with considerable uniformity both from a paleontological and lithological basis. The Bossardville in Hardy County is much more fossiliferous than the Rondout below. It is characterized by the thin ribbony limestones which in places carry numerous Hindella congregata and elsewhere Stromatopora, Bryozoa, etc. As a rule the limestones toward the base of the Bossardville are more massive and resistant to weathering than the Rondout strata below. Toward the eastern part of the county there is a sandstone bed at the base of the Bossardville which makes the separation of the two formations rather easy. (See section of this contact under description of Rondout, page 261, also bottom Bossardville sandstone described in columnar section in this Chapter dealing with Bossardville, page 264).

Fossils.—The formation as a whole is sparingly fossiliferous, although there are beds which carry great numbers of a few species of fossils, as Hindella congregata, Favosites niagarensis, Stromatopora cf. constellata. In the Turkey Mountain area toward the western part of the county Camarotoechia litchfieldensis is common toward the top of the formation. No well-defined zone of Spirifer vanuxemi was seen in Hardy County. The Hindella congregata zone is well defined and occupies the middle and lower third of the formation. In most sections there is a very well-developed Stromatopora bed about 100 feet above the base of the formation, but the Stromatopora reefs occur in different places from the middle to the base of the formation. Leperditia alta is common in some beds and ranges from near the base to near the top of the formation. Streptelasma sp. and Aulopora sp. are common in the Hindella congregata zone. In the McCauley Section, page 264, the Hindella congregata zone takes in Nos. 6 to 12, inclusive; the Stromatopora zone, Nos. 9 and 10. Fossils identified from the Bossardville are: Hindella congregata, Leperditia alta, Favosites niagarensis, Stromatopora cf. constellata, Hormotoma rowei, Stropheodonta sp., Aulopora sp., Leperditia sp., Camarotoechia sp.

Collections were made at fossil localities 12, 13, 31, 34, 44, (top), 53, 54, and 55, as follows:

Collection 12.

In road, 1/3 mile southwest of Turkey Mountain, 1.2 miles northwest of Kessel.

Coelenterata
- Stromatopora sp.

Collection 13.

In road, at point 1/3 mile southwest of Turkey Mountain, 1.2 miles northwest of Kessel.

Echinodermata
- Crinoid stem sp.

Molluscoidea
- **Brachiopoda**
  - Hindella cf. congregata Swartz
  - Homeospira sp.

Arthropoda
- Ostracod sp.

Collection 31.

On second-class road over Mill Creek Mountain, 0.7 mile northwest of Glebe Station (Sector P. O.), Hampshire County.

Molluscoidea
- **Brachiopoda**
  - Camarotoechia sp.

Arthropoda
- Ostacod sp.
- Leperditia sp.

Collection 34.

On second-class road, 7/8 mile northeast of High Knob.

Arthropoda
- Ostracod sp.
- Leperditia sp.

Collection 44.

Top. Near Ketterman School, on public road.

Molluscoidea
- **Brachiopoda**
  - Camarotoechia litchfieldensis Schuchert

Arthropoda
- Leperditia sp.

Collection 53.

23 feet below Stromatopora bed, 1.4 miles southeast of Williamsport.

Molluscoidea
- **Brachiopoda**
  - Hindella congregata Swartz
  - Stropheodonta sp.

Arthropoda
- Leperditia alta (Conrad).

Collection 54.

10 feet below Stromatopora bed, 1.4 miles southeast of Williamsport.

Coelenterata
- Stromatopora constellata Hall
- Favosites niagarensis Hall
- Streptelasma sp.

Molluscoidea
- **Bryozoa**
  - Aulopora sp.
- **Brachiopoda**
  - Hindella congregata Swartz

Collection 55.

3/4 mile south of Twin Mountain.

Molluscoidea
- **Brachiopoda**
  - Hindella cf. congregata Swartz

Mollusca
- **Gastropoda**
  - Hormotoma rowei Swartz

Arthropoda
- Leperditia sp.

The Bossardville differs in its lithological constitution in various parts of the county but in general there is sufficient similarity to warrant subdivision. There is a relatively non-fossiliferous upper portion composed of limestone and calcareous shales, below this a sandstone and shale division, which seemingly corresponds to the Indian Spring horizon of the Tonoloway Formation in Maryland,[4] and a lower relatively thicker bedded and more highly fossiliferous limestone portion. In some localities there is a sandstone at the base, as in the McCauley section.

Economic Conditions.—Many of the limestone beds in the Bossardville are sufficiently pure to be used for agricultural lime and some of them could be used in the manufacture of Portland cement. A large percentage of the Bossardville Limestone is especially suitable for crushing, due to the fact that the beds are thin and the stone compact and brittle. Its best use would be in road macadam, concrete, or ballast.

The following is an analysis of a sample (No. 1PH, Laboratory No. 2942) of Bossardville Limestone collected by Paul H. Price as analyzed by B. B. Kaplan, Chemist of the Survey, from quarry 2 miles northeast of Baker:

	Per cent.
Silica (SiO_2)	6.10
Ferric Iron (Fe_2O_3) and Alumina (Al_2O_3)	0.70
Calcium Carbonate ($CaCO_3$)	90.20
Magnesium Carbonate ($MgCO_3$)	0.71
Loss on Ignition	1.98
Total	99.69

[4]Silurian Report, Maryland Geological Survey, page 46; 1923.

A sample of the Bossardville Limestone was collected by Tucker (19T, Laboratory No. 2953) 1.1 miles southeast of Lost River P. O., the analysis of which by B. B. Kaplan, Chemist of the Survey, shows as follows:

	Per cent.
Silica (SiO_2)	4.30
Ferric Iron (Fe_2O_3)	0.37
Alumina (Al_2O_3)	0.43
Calcium Carbonate ($CaCO_3$)	86.80
Magnesium Carbonate ($MgCO_3$)	7.50
Phosphoric Acid (P_2O_5)	0.016
Loss on Ignition	0.45
Total	99.866

Two samples of Bossardville Limestone were also collected by Tucker (No. 22-T, Laboratory No. 2956, and No. 23-T, Laboratory No. 2957) from the property of Henry Heisghman along road 1.5 miles south of McCauley on the east branch of Three Springs Run, at which point there is also a deposit of marl from which two samples were also collected by Tucker. The samples were analyzed by B. B. Kaplan, Chemist of the Survey, who reports the results as follows:

	22-T. Per cent.	23-T. Per cent.
Silica (SiO_2)	13.30	13.20
Ferric Iron (Fe_2O_3)	0.43	0.68
Alumina (Al_2O_3)	0.97	0.92
Calcium Carbonate ($CaCO_3$)	83.60	82.00
Magnesium Carbonate ($MgCO_3$)	1.20	1.41
Phosphoric Acid (P_2O_5)	trace	0.021
Loss on Ignition	0.60	1.24
Totals	100.10	99.471

The analyses of the two samples of marl from the lands of Henry Heisghman collected by Tucker along road 1.5 miles south of McCauley on the east branch of Three Springs Run, deposited just below the outcrop of the Bossardville Limestone which was also sampled, as reported by B. B. Kaplan, Chemist for the Survey, under Sample No. 24-T (Laboratory No. 2958) and Sample No. 25-T (Laboratory No. 2959), are as follows:

	24-T. Per cent.	25-T. Per cent.
Silica (SiO_2)	22.16	11.70
Ferric Iron (Fe_2O_3)	0.72	0.47
Alumina (Al_2O_3)	1.28	0.97
Calcium Carbonate ($CaCO_3$)	73.84	83.60
Magnesium Carbonate ($MgCO_3$)	0.81	1.65
Phosphoric Acid (P_2O_5)	0.025	trace
Loss on Ignition	0.97	1.00
Totals	99.805	99.39

DEVONIAN PERIOD.

There is a more complete record of the Devonian time in the exposed rocks of Hardy County than of any other period. Of the 14,000 feet of thickness of the strata exposed in the county, 10,000 feet is of Devonian age. The larger portion of this belongs to the Middle Devonian and Upper Devonian. Probably from 80 to 90 per cent. of the surface of Hardy County is occupied by rocks of this system.

Along the Hampshire-Hardy line which has a length of 30 miles, there are but 2.5 miles of Silurian outcrop. The rest is Devonian. The boundary between Hardy County on the one side and Grant, Pendleton, and Rockingham (Virginia), on the other side, is about 39 miles long. Of this only 5 miles has Silurian and Ordovician rocks, and the rest is Devonian.

The greatest thickness of the Devonian is exposed in the large synclinal areas in the central portion of the county. A belt of rocks 12 miles wide running northeast and southwest through the central part of the county is entirely of Devonian age. Locally this belt is much wider.

West of the Lost City-Lost River Valley, the only portions of the county which have other than Devonian rocks are Patterson Creek and Elkhorn Mountain Anticlines and a very small outcrop on the Broad Top (Stratford Ridge) Anticline.

The Lower and Middle Devonian are represented by marine sediments of limestone, sandstone, and shale character, with a considerable percentage of calcareous deposits. The Upper Devonian is more largely shaly and sandy and ends with a great thickness of fresh-water and land deposits with occasional marine invasion.

Devonian Subdivisions.

The following larger subdivisions of the Devonian are recognized in Hardy County:

		Epoch.	Age.	Thickness.
DEVONIAN PERIOD	Upper Devonian	Catskill		(2500′-3700′)
		Chemung		(2200′-2500′)
		Portage		(1200′-1800′)
		Genesee		(150′- 350′)
	Middle Devonian	Hamilton		(300′- 800′)
		Marcellus		(500′- 800′)
	Lower Devonian	Oriskany	Ridgeley	(100′- 200′)
			Shriver	(50′- 140′)
		Helderberg	New Scotland	(0′- 35′)
			Coeymans	(5′- 25′)
			Keyser	(250′- 350′)

The following outline map of Hardy County, prepared by Paul H. Price, shows the areal extent of the Devonian Rocks in the area:

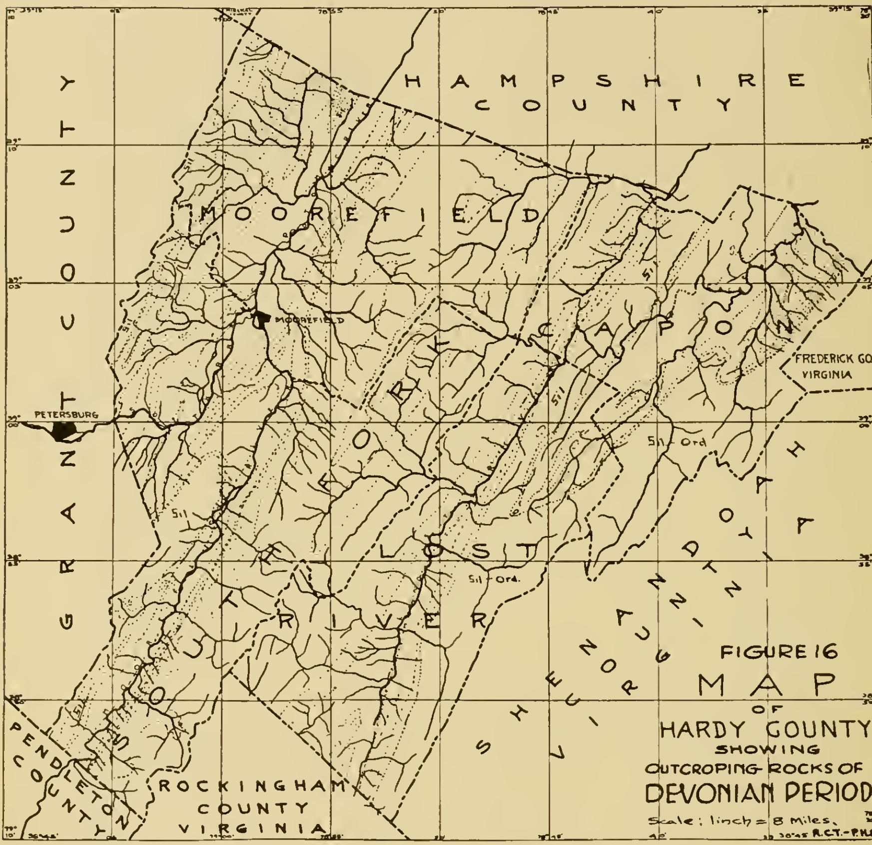


FIGURE 16
MAP
OF
HARDY COUNTY
SHOWING
OUTCROPING ROCKS OF
DEVONIAN PERIOD

LOWER DEVONIAN.

Stratigraphy.—The Lower Devonian is composed of the Helderberg Limestone below and the Oriskany Sandstone above. These together have an average thickness of about 600 feet. In places the total thickness may reach about 800 feet. The Helderberg is the thicker of the two. The following are typical sections of the Lower Devonian:

Section through Oriskany and Helderberg beginning along road 1.1 miles northwest from Thrasher Spring School.

	Feet.	
Marcellus Black Shale.		
Oriskany Sandstone (339′).		
Non-cherty member (Ridgeley, 203′) carrying:		
Spirifer arenosus (Conrad)		
cf. Oriskania lucerna Schuchert		
Stropheodonta sp.		
Spirifer cf. murchisoni Castelnau		
Meristella sp.		
Cup coral.		
Rather coarse-grained and easily weathered calcareous and fossiliferous sandstone	90	
More siliceous and less fossiliferous coarse-grained sandstone	20	
Coarse-grained calcareous sandstone	93	203
Cherty member (Shriver, 136′)		
Black chert in calcareous sandstone with some crystalline dark limestone	62	
Same as above but having 50 per cent. or more of chert	74	136
Helderberg Limestone (374.5′)		
New Scotland (20′), with many fossils:		
Hindia sphaeroidalis Duncan		
Leptaena rhomboidalis (Wilckens)		
Spirifer macropleurus (Conrad)		
Eatonia singularis (Vanuxem)		
Eatonia medialis (Vanuxem)		
Platyceras sp.		
Massive white chert	5	
Thin-bedded, white-weathering, cavernous chert, and with many fossils	15	20
Coeymans (9.5′) dark, crinoidal limestone carrying:		
Atrypa reticularis (Linne)		
Gypidula coeymanensis Schuchert		
cf. Rhipidomella oblata (Hall)		
Spirifer cf. octocostatus Hall		
Spirifer cf. cyclopterus Hall	9.5	9.5

	Feet.	
Keyser (345')		
Fine-grained dark limestone, few fossils	7	
Fine-grained, blue, laminated limestone, resembling beds in the Bossardville	17	
Massive, dark, fine-grained limestone (Tentaculites zone) Fossils: Tentaculites gyracanthus (Eaton), cf. Meristella praenuntia Schuchert	5	
Dark, irregular-bedded, very fossiliferous limestone: Brachiopods, bryozoa, and near base, Stromatopora	38	
Thin-bedded, argillaceous, light-gray limestone with shale partings	20	
More massive, dark-colored limestone, rather fossiliferous	60	
Shaly and nodular limestone with an occasional chert layer	28	
Concealed	20	
Heavier-bedded limestone, weathering into irregular pieces (nodular)	150	345

Section of Oriskany and most of the Helderberg, on west slope of Elkhorn Mountain, 2 miles east of Durgon.

Black Shale of the Marcellus.

	Feet.
Oriskany Sandstone (274')	
Ridgeley non-cherty member (141')	
Rather coarse-grained, formerly calcareous sandstone with many fossils: Spirifer arenosus, Rensselaeria ovoides, Tentaculites sp. (glass-sand layer)	30
Very heavy bed of light-gray, siliceous sandstone, stands very high in wall (Plate LXIV), very few fossils	22
Less massive siliceous, gray sandstone	17
Ferruginous sandstone, many fossils, Spirifer arenosus, etc.	5
Thin-bedded, gray to brown sandstone, few fossils	38
Dark-gray to brown, thin-bedded and shaly sandstone, fossils common	15
Like the above but containing a few chert concretions	5
More massive sandstone and more chert	6

Somewhat cherty and very fossiliferous sandstone:

Leptaena rhomboidalis var. ventricosa (Hall)
Schuchertella woolworthana (Hall)
Schuchertella cf. becraftensis (Clarke)
cf. Chonetes hudsonicus Clarke
Spirifer tribuarius var. pauciplicatus n. var.
Spirifer cf. cumberlandiae Hall
Spirifer paucicostatus Schuchert
Spirifer intermedius Hall
Spirifer angularis Schuchert
Spirifer angularis var. tribulis v. nov.
Rensselaeria (Beachia) suessana var. immatura Schuchert
Anoplotheca flabellites (Conrad)
Meristella lentiformis Clarke

	Feet.	
Tentaculites elongatus Hall	3	141
Shriver Chert Member (133′)		
Very fine-grained, calcareous sandstone and dark-gray limestone with concretionary, black chert throughout and increasing toward the bottom. (In bottom 35 feet chert is more than 50 per cent. of the rock). Bottom carries some poorly preserved ostracods	120	
Shaly sandstone with little or no chert	5	
Shaly and calcareous sandstone, few fossils, collection from top foot: Anoplotheca dichotoma Hall; Leptaena rhomboidalis (Wilckens)	8	133
Helderberg Limestone (312′+)		
New Scotland (29′)		
Shaly and calcareous sandstone, collection from bottom foot: Orbiculoidea aff. discinisca (Hall); Leptaena rhomboidalis (Wilckens); cf. Dalmanella perelegans (Hall); Spirifer cyclopterus Hall; Spirifer concinnus Hall; Spirifer perlamellosus Hall; cf. Eatonia medialis (Vanuxem); Eatonia lirata n. sp.; Meristella cf. arcuata (Hall)	2	
Cherty, medium-grained, dark-gray limestone with much white-weathering chert in thin to irregular beds, top few feet with little shale, but containing Spirifer macropleurus	27	29
Coeymans (26.5′)		
Crystalline gray crinoidal limestone, many Gypidula coeymanensis	26.5	26.5
Keyser (256.5′)		
Gray calcareous shale	4	
More compact, darker gray limestone with many crinoid stems and bryozoa	10	
Nodular gray limestone, collection: Strophonella keyserensis Swartz (C. K.); Stenochisma formosa Hall; Meristella praenuntia Schuchert; Stromatopora sp.; Crinoid sp.	9	
More massive and granular, gray limestone, great numbers of small crinoid stems and branching bryozoa	13.5	
Nodular limestone, with many Favosites	5	
Nodular limestone, with few fossils, chert in thin layers 10 feet above base	45	
Concealed	20	
Granular limestone, with Favosites	2	

	Feet.
Concealed	15
Gray limestone, like above, with brachiopods and bryozoa	3
Concealed	70
Coarse-grained, very nodular, gray limestone like above, dip E. 40 degrees	50
Shaly limestone	10 312+
Concealed	

HELDERBERG LIMESTONE.

General Character.—At the present time the base of the Helderberg is considered the line of division between the Silurian and the Devonian. This series of rocks is entirely of marine character and as a rule quite fossiliferous. At base it is largely a nodular and heavy-bedded limestone. Toward the middle it becomes more shaly. Toward the top are more massive and crinoidal limestones, and at the top, forming the upper member of the Helderberg, is a bed of massive white-weathering and very fossiliferous chert.

Topography.—The massive chert at the top of the Helderberg, together with the overlying Oriskany Sandstone, makes a very resistant horizon, which forms the crests of many steeply inclined ridges.

The Helderberg Limestone is usually found on the slopes of mountains and seldom in the valleys or the crests of anticlines, Patterson Creek Mountain Anticline being an exception. Wherever the Oriskany and the Helderberg chert layers are worn through, down-cutting of the underlying beds is hastened and precipitous cliffs result, frequently several hundred feet high.

In localities where the contact between the chert and the Oriskany outcrops at a steep angle, there is frequently a sharp ridge or "hogback" running along the mountain slope. Streams cutting across these layers make notches in the "hogback" and the result is a series of knobs referred to as "potato knobs". See Plate LXV.

Distribution.—In the eastern part of the county there is a narrow outcrop of Helderberg running from Rockingham County, Virginia, on the southwest, to Hampshire County, on the northeast. This strip is everywhere on the slope to the east of the Lost River Valley. Toward the south it occurs on the west limb of the Adams Run Anticline, and to the north on the west limb of the Hanging Rock Anticline. The Helderberg outcrop, on the east side of the Hanging Rock Anticline, turns to the east in the latitude of Lost River and runs northeastwardly along the western limbs of the Anderson Ridge Anticline and the Sugar Knob Anticline.

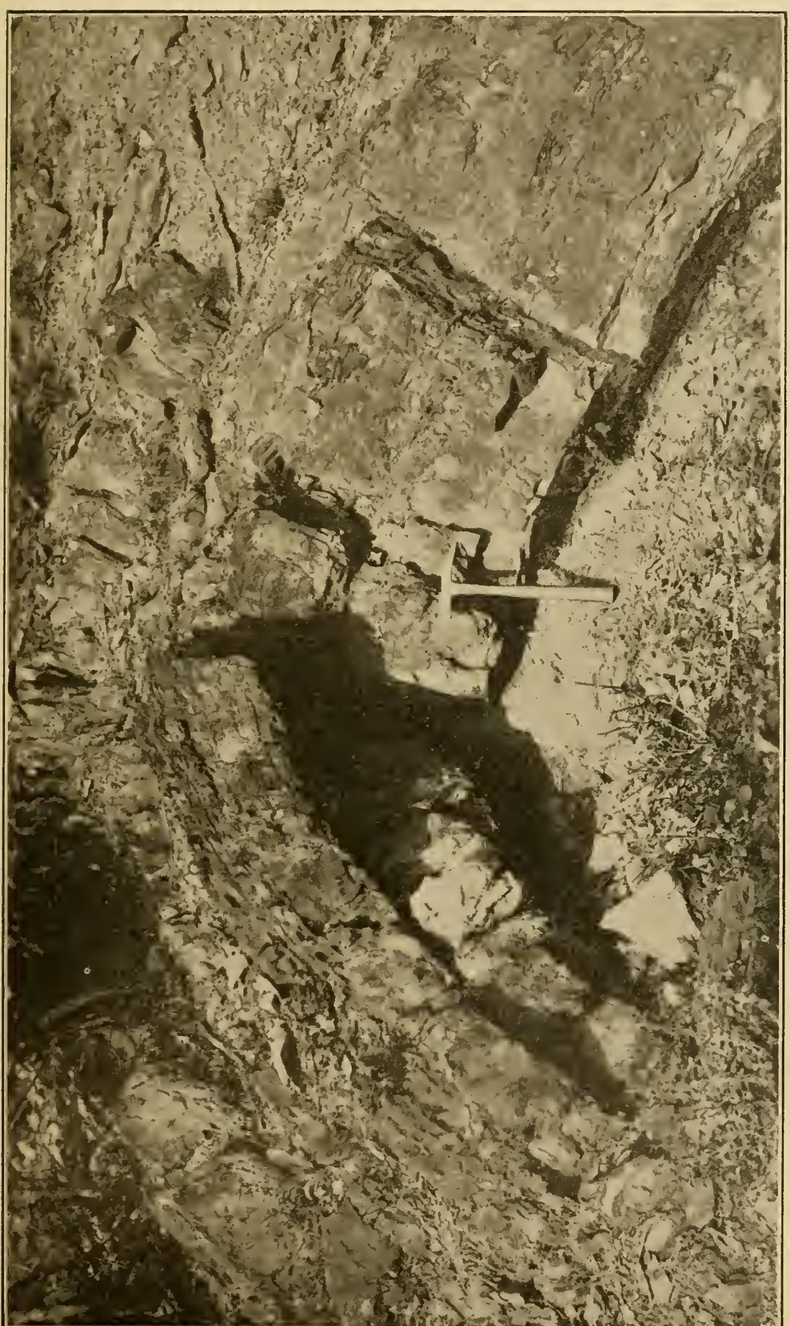


PLATE LXII.—Folding of this character is common in the less resistant shales and limestones or shales and thin-bedded sandstones. This slightly unsymmetrical fold occurs in the lower portion of the Helderberg Formation, Elkhorn Mountain.

In the general basin structure, lying between Hanging Rock Anticline and the two large eastern anticlines, much of the surface is covered by outcropping Oriskany, with very slight dip. A small arch extending northward from the Adams Run Anticline brings up a considerable width of outcrop of Helderberg along both sides of Thorny Bottom. There are no exposures of Helderberg through the center of the county.

In Elkhorn Mountain Anticline, the Oriskany arch gives way to the Helderberg and underlying formations at a point about 2 miles north of Bass. From here southwestwardly the Helderberg outcrops on both flanks of the anticline as far as the county line, the outcrop on the east limb being much broader, because of minor folding, and for 6 miles north from the Pendleton County line on this east side the outcrop is in two parallel belts separated by a strip of Bossardville Limestone.

In Mill Creek Mountain the Helderberg has a small outcrop reaching in a loop southward from the Hampshire County line a little over 2 miles. Here also minor folding has repeated the Helderberg outcrop. (See Figure 12).

The most extensive outcrop of the Helderberg occurs on the crest and slopes of Patterson Creek Mountain. The county line runs along the crest of this anticlinal mountain, so that only the east half is in Hardy County. This outcrop on the east slope is in places about one mile wide, and the belt is continuous from the Grant County line, just north of Petersburg, to the Hampshire County line, a distance of about 15 miles.

Contacts.—The contact with the Bossardville below is usually easy to draw, as the Keyser Member usually has at the base a rather massive and nodular limestone rather highly fossiliferous and resistant to weathering. There is, therefore, usually a topographic change at the contact. The Bossardville is thin-bedded and has few fossils. There are, locally, beds in the Helderberg which are of the same lithological character as the typical Bossardville.

Despite the rather marked difference in lithology and faunal character, one can not believe the time gap between these two limestones to be of any great duration. Seemingly a much shorter time gap is recorded than is usual between periods.

The top contact with the Oriskany is without doubt a line of unconformity since the Becraft beds of the Helderberg are missing from the exposures in the county and because the New Scotland, which forms the top of the Helderberg in West Virginia, is much thinner or absent in a few places.

Collections were made at fossil localities 9 (New Scotland), 10 (Keyser), 11 (Keyser), 21 (New Scotland), 24 (Coeymans), 25 (Keyser), 43 (basal Keyser), 46 (basal Keyser), 103 (New Scotland), and 104 (Keyser), as follows:

Collection 9.

In road, ⅓ mile south of Turkey Mountain. New Scotland Chert.

Molluscoidea
  Bryozoa
    Ramose bryozoa
Brachiopoda
    Meristella sp.
    Rhipidomella cf. oblata Hall
    Spirifer macropleurus (Conrad).

Collection 10.

Keyser Member. In road, 1/3 mile north of Turkey Mountain.

Coelenterata
    Favosites helderbergiae Hall
Molluscoidea
  Brachiopoda
    Rensselaeria sp.

Collection 11.

Keyser Member. In road, ⅓ mile southwest of Turkey Mountain.

Coelenterata
    Favosites helderbergiae Hall
    Favosites helderbergiae var. praecedens Schuchert.

Collection 21.

New Scotland Chert. 1.8 miles southeast of Williamsport.

Porifera
    Hindia sphaeroidalis Duncan
Molluscoidea
  Brachiopoda
    Eatonia medialis (Vanuxem).
    Eatonia singularis (Vanuxem)
    Leptaena rhomboidalis (Wilckens)
    Spirifer macropleurus (Conrad)
    Spirifer sp.
Mollusca
  Gastropoda
    Platyceras sp.

Collection 24.

Coeymans. Crinoidal limestone just below New Scotland.
1.8 miles southeast of Williamsport.

Molluscoidea
  Brachiopoda
    Atrypa reticularis (Linne)
    Gypidula coeymanensis Schuchert
    Rhipidomella cf. oblata Hall
    Spirifer cf. cyclopterus Hall
    Spirifer cf. octocostatus Hall

Collection 25.

Keyser Member, Tentaculites subzone just below Coeymans, 1.8 miles northeast of Williamsport.

Molluscoidea
- **Brachiopoda**
  - Meristella sp.

Mollusca
- **Pteropoda**
  - Tentaculites gyracanthus (Eaton).

Collection 43.

Basal Keyser. Near Ketterman School, on public road.

Coelenterata
- Stromatopora constellata Hall
- Favosites helderbergiae Hall
- Halysites cf. catenulatus (Linne).

Collection 46.

Basal Keyser. 1/4 mile northwest of Bass P. O.

Molluscoidea
- **Bryozoa**
  - Diplostenopora cf. siluriana (Weller)
- **Brachiopoda**
  - Camarotoechia cf. litchfieldensis Schuchert

Mollusca
- **Pelecypoda**
  - Aviculopecten sp.
- **Pteropoda**
  - Tentaculites gyracanthus (Eaton).

Collection 103.

New Scotland Chert. 11 feet below Locality 202, 2 miles northwest of Bass P. O.

Molluscoidea
- **Brachiopoda**
  - Dalmanella perelegans (Hall)
  - Eatonia medialis (Vanuxem)
  - Eatonia lirata sp. nov.
  - Leptaena rhomboidalis (Wilckens)
  - Meristella cf. arcuata (Hall)
  - Orbiculoidea discinisca (Hall)
  - Spirifer concinnus Hall
  - Spirifer cyclopterus Hall
  - Spirifer perlamellosus Hall.

Collection 104.

Keyser Member. 110 feet below Locality 103, 2 miles northwest of Bass P. O.

Molluscoidea
- **Brachiopoda**
  - Meristella praenuntia Schuchert
  - Stenochisma formosa Hall
  - Strophonella keyserensis Swartz.

Fossils.—The Helderberg fossils identified in the three subdivisions are:

Keyser: Favosites helderbergiae, Favosites helderbergiae var. praecedens, Rensselaeria sp., Meristella praenuntia, Tentaculites gyracanthus, Halysites cf. catenulatus, Stromatopora cf. constellata, Camarotoechia litchfieldensis, Whitfieldella cf. minuta, cf. Diaphorostoma siluriana, Aviculopecten sp., Strophonella keyserensis, Stenochisma formosa.

New Scotland: Spirifer macropleurus, Rhipidomella cf. oblata, Meristella sp., Hindia sphaeroidalis, Leptaena rhomboidalis, Eatonia singularis, Eatonia medialis, Platyceras sp., Orbiculoidea aff. discinisca, Dalmanella perelegens, Spirifer cyclopterus, Spirifer concinnus, Spirifer perlamellosus, Eatonia lirata n. sp., Meristella arcuata.

Coeymans: Atrypa reticularis, Gypidula coeymanensis, Rhipidomella oblata, Spirifer cf. octocostatus, Spirifer cf. cyclopterus.

Subdivisions of Helderberg Limestone.—Of the four subdivisions of the Helderberg recognized by the Maryland Geological Survey but three occur in Hardy County. The upper division, Becraft, is entirely absent. The other three divisions: the Keyser, the Coeymans, and the New Scotland, named in order from the bottom up, are represented, and are easily distinguished both in lithology and fossil content.

Keyser Limestone.—At base of this division is a massive nodular-weathering limestone, which gives place higher up to thinner-bedded limestones with shale partings. Toward the top more massive and compact limestones are common. In the Maryland Devonian Report, the Keyser is subdivided into faunal zones as follows:

KEYSER	Favosites helderbergiae var. praecedens zone	Leperditia subzone. Corriganville Upper Stromatopora reef. Tentaculites gyracanthus subzone. Corriganville Lower Stromatopora reef. Rensselaeria mutabilis subzone. Keyser coral reef.
	Chonetes jerseyensis zone	Bryozoan subzone. Gypidula coeymanensis var. prognostica subzone. Spirifer modestus-cystid subzone. Rawlings Stromatopora reef. Cladopora rectilineata subzone. Rhynchospira subzone Warrior Mountain coral reef.

None of the sections examined in Hardy County show the entire thickness of the Keyser and no detailed collections were made, except from the top portion in the Thrasher Spring School Section. Here the Tentaculites gyracanthus and the Lower Stromatopora subzones of the Favosites helderbergiae var. praecedens zone are well developed. In many localities exposures in the upper portion of the Keyser show the Tentaculites subzone. At Sector P. O. in Hampshire County, the Tentaculites subzone comes in about 50 feet below the bottom of the New Scotland. Locally, as in outcrop of the upper portion of the Keyser on Mill Creek Mountain, near High Knob, the ground is strewn with beautifully weathered-out specimens of Favosites and Stromatopora.

In most localities there are at least two well-developed Stromatopora beds. One is usually high in the Keyser and the other is near the base.

Coeymans.—In all sections showing the upper portion of the Helderberg, the Coeymans is present. It is represented by a crystalline, dark-gray, crinoidal limestone, which has a thickness of from 10 to 30 feet and which carries a number of fossils including Gypidula coeymanensis, its guide fossil. For list of fossils see Thrasher Spring School Section, page 341, and Elkhorn Mountain Section, page 343.

New Scotland.—The New Scotland is present in most of the sections of the Helderberg studied in Hardy County. It is usually a medium-grained, dark-gray limestone with much white-weathering chert in thin to irregular beds. The most typical weathered exposures of the New Scotland show no limestone but only massive to thin-bedded white and cavernous chert, full of fossils and with many Spirifer macropleurus (the guide fossil) and Leptaena rhomboidalis in the greatest profusion. The New Scotland is usually about 25 feet thick. The Thrasher Spring School Section and the Elkhorn Mountain Section are typical of the members of the Helderberg. At Sector P. O. the New Scotland is about 40 feet thick and includes about 15 feet of only slightly cherty, light-gray limestone at its base, below which comes the crinoidal layer of the Coeymans. In the Elkhorn Mountain Section, pages 342-3, we have a section through top New Scotland and bottom Oriskany showing a shaly and calcareous sandstone as the basal rock in the Oriskany.

Becraft.—No rocks of Becraft time are known to occur in Hardy County unless the 2-foot layer of shaly and calcareous sandstone occurring at the very top of the Helderberg, in the Elkhorn Mountain Section (page 343), and provisionally re-

PLATE LXIII.—Typical exposure of the New Scotland Chert (thinner-bedded layers on the left), and the Shriver Chert of the Oriskany (the massive bed on the right-hand side of the photograph). Moorefield-Williamsport road, ¾ mile west of Thrasher Spring School and about 2 miles southeast of Williamsport.

ferred to the New Scotland, may represent a brief portion of Becraft time. This 2-foot bed contains Spirifer concinnus, which, in Maryland, but not in New York or New Jersey, is confined to the Becraft.

Economic Aspects.—Many of the limestone beds in the Helderberg are high in calcium carbonate and are excellent for lime-burning or for the manufacture of Portland cement. This lime could also be crushed and used for a number of purposes such as road surfacing, ground agricultural lime, or for concrete. The New Scotland Cherts, together with the Shriver Cherts, make excellent soils on the ridges for peach and apple growing.

A sample of the Helderberg Limestone from near Riley Strawderman's house 1.1 miles southeast of Lost River P. O. was collected by Tucker for analysis by B. B. Kaplan, Chemist of the Survey, who reports the following results (Sample No. 20-T, Laboratory No. 2954):

	Per cent.
Silica (SiO_2)	6.80
Ferric Iron (Fe_2O_3)	0.25
Alumina (Al_2O_3)	0.95
Calcium Carbonate ($CaCO_3$)	90.60
Magnesium Carbonate ($MgCO_3$)	0.68
Phosphoric Acid (P_2O_5)	0.024
Loss on Ignition	1.10
Total	100.404

The limestone from this local quarry was formerly burned in a lime-kiln for domestic use.

ORISKANY SANDSTONE.

General Characteristics.—The Oriskany Sandstone is composed of two quite distinct parts, an upper coarse-grained and formerly calcareous sandstone and a lower, finer-textured, more calcareous sandstone, with some crystalline, dark limestone and much black chert. In many areas the top few feet of the Oriskany is a bluish-gray arenaceous sandstone which is not ridge forming and which weathers into loose-textured sandstone suitable for glass-sand. In some areas pebbles about the size of wheat grains are common toward the base of the layer. The particles forming the Oriskany Sandstone are usually pure quartz and much rounded by erosion.

Thickness.—At the Thrasher Spring School Section pages 340-1) the Oriskany is 339 feet thick, at Elkhorn Mountain Section it is 255 feet thick, near Sector P. O., in Hampshire County, it is about 330 feet thick. Just west of Brake the Oriskany measures 320 feet. In most of these sections the non-cherty upper section is the thicker.

PLATE LXIV.—"Wall rock" of Oriskany Sandstone, 2 miles east of Durgon, on west limb of Elkhorn Mountain Anticline. (For description, see page 290.

DESCRIPTION OF PLATE LXIV.—"Wall rock" formed by the nearly vertical outcrop of the upper and more resistant portion of the Oriskany Sandstone, west limb of the Elkhorn Mountain Anticline, 2 miles east of Durgon. The rock is practically vertical at the base, but higher up the wall arches slightly toward the east. This bed of more resistant sandstone is about 22 feet thick and occurs just below the top, calcareous sandstone, of the Oriskany, which frequently weathers into a very loose-grained and very white sandstone, of "glass-sand" type, and is very fossiliferous, carrying many Spirifer arenosus, Rensselaeria ovoides, Tentaculites sp., etc. The "wall rock" sandstone is very sparingly fossiliferous (see section, page 342; also description of Elkhorn Mountain Anticline, page 209).

Topography.—All of the anticlinal hills in Hardy County are held up by the Oriskany Sandstone,' with the exception of the central portion of the Elkhorn Mountain Anticline. Many of the canoe-shaped anticlinal ridges so common in and to the west of the Moorefield Valley are completely covered by Oriskany Sandstone. Practically every big anticline in the area, where it rises from beneath the flatter bottom lands, is covered with Oriskany. Some of these anticlines have reached an elevation of 1500 feet above the valley, before erosion has succeeded in piercing the sandstone.

In places, as along the west side of Elkhorn Mountain, when the wider western limb of the anticline is very steep, a wall of sandstone frequently reaches elevations of from 100 to 150 feet. The best example of this "wall-rock" development is to been just to the east of Durgon, Plates XLVII and LXIV. A similar outcrop is seen on the west side of Mill Creek Mountain. Remnants of Oriskany maintain elevations in many places in the county. Some of the more conspicuous examples of such are to be found on the Huckleberry Ridge, Patterson Creek Mountain, High Knob, on Mill Creek Mountain, numerous places in the southern part of Elkhorn Mountain, and much of the flat-rock elevated country along Buck Mountain and Sandy Ridge.

Areal Extent.—The Oriskany has, next to the Catskill and Chemung, the largest outcrop area of any of the formations in Hardy County. The most extensive outcrop is to the east of the Lost River Valley and to the west of the older rock outcrops in the three great eastern anticlines. Here the chief exposure is in the higher and relatively flat-rock country of the combined Wardensville and Sandy Ridge Synclines, also the northern nose of the Anderson Ridge Anticline. Of these outcrops that in the Sandy Ridge Syncline is the most conspicuous. It has a width of from 1 to 2.25 miles for a length of outcrop of over 16 miles. In this same area, on the east side of the Lost River Valley, there is a continuous outcrop entirely across the county (28 miles).

About two miles south of Moorefield a plunging anticlinal fold brings up the Oriskany which caps the mountain in its increasing elevation to the south. Four miles south of the north end of the exposure, the Oriskany arch is entirely cut through by erosion and the Oriskany outcrop branches. The one on the west extends to the Grant County line in a very narrow outcrop. The eastern branch, extending a much longer distance to the Pendleton County line, has a low angle of dip, and, due to minor folding on this side of the fold, has broad parallel outcrops.

Beginning about 5 miles north of Moorefield is an extensive Oriskany outcrop in the Broad Top (Stratford Ridge) Anticline, the Middle Mountain ("Trough") Syncline, and the Sawmill Ridge Anticline. To the northwest of Moorefield in the Marcellus Shale valley occur a number of beautifully developed anticlinal hills, with the entire surface formed of Oriskany Sandstone. The smallest of these is about one-half mile in length and the largest about 8 miles.

Another extensive outcrop of Oriskany occurs on the east limb of the Patterson Creek Mountain Anticline. Here the outcrop is much widened by the minor folding, and 18 miles in length in Hardy County.

Contacts.—The contact of the bottom of the Oriskany with the Helderberg is everywhere a line of unconformity, since the Becraft does not occur in Hardy County. Ordinarily the line between the New Scotland and the Oriskany is easy to draw, as for example in the Thrasher Spring School Section (page 341), but locally it is more difficult to draw a sharp line, as in the Elkhorn Mountain Section.

The upper contact is less often visible than the bottom contact, but where seen, it is a well-marked line, the calcareous sandstone changing suddenly into the fine-textured black or gray shales of the Marcellus. The faunal change is also very marked. The abundant brachiopod life gives way to the scanty and dwarf pelecypod and pteropod life. The Esopus and Schoharie times seem not to be represented in the Hardy County sections.

Fossils.—Taken as a whole the Oriskany is very unusually fossiliferous for a sandstone. This is explained by its general limy character. Brachiopods, pelecypods, and gastropods are the most abundant, the top highly calcareous sandstone being the most fossiliferous portion. Here the typical Spirifer arenosus occurs in greatest abundance, also Rensselaeria ovoides, and Hipparionyx proximus are very common.

The fossils of the Oriskany identified in Hardy County are: Spirifer arenosus, Spirifer murchisoni, Hipparionyx proximus, Platyceras gebhardi var. ventricosum, Rensselaeria cf. suessana, Tentaculites elongantus, Cyrtina close to rostata, Oriskania lucerna, Spirifer cumberlandiae, Spirifer angularis, Stropheodonta magniventra, Orbiculoidea sp., Lingula sp., Schuchertella woolworthana, Schuchertella becraftensis, Chonetes hudsonicus, Spirifer tribuarius, Spirifer perdewi, Spirifer paucicostatus, Spirifer intermedius, Spirifer angularis, var. tribulis var. nov. Rensselaeria suesann var. immatura, Anoplotheca flabellites, Meristella lentiformis, Bellerophon sp., Crinoid stems, Platyceras cf. gracile.

Collections were made at fossil localities 5 (upper), 6 (Ridgeley), 22 (Shriver Chert), 23 (Ridgeley), 51, 101 (Ridgeley), and 102 (Shriver Chert), as follows:

Collection 5.

Upper Oriskany. By road, 0.6 mile southeast of Kessel, but higher in formation than Locality No. 6.

Molluscoidea

Brachiopoda

Hipparionyx proximus Vanuxem
Rensselaeria cf. suessana
Spirifer arenosus (Conrad)
Spirifer murchisoni Castelnau
Spirifer tribuarius Schuchert and Maynard

Mollusca

Gastropoda

Platyceras gebhardi var. ventricosum Conrad

Pteropoda

Tentaculites elongatus Hall.

Collection 6.

Ridgeley Member. By road, 0.6 mile southeast of Kessel.

Molluscoidea

Brachiopoda

Spirifer arenosus (Conrad)
Spirifer angularis Schuchert
Spirifer cumberlandiae Hall
Spirifer intermedius Hall
Spirifer perdewi Schuchert

Mollusca

Gastropoda

Platyceras cf. gracile Ohern.

Collection 22.

Shriver Chert. No fossils. Cherty Limestone. 1.8 miles southwest of Williamsport.

Collection 23.

Ridgeley Member. 1.8 miles southeast of Williamsport.

Coelenterata

Cup coral sp.

Molluscoidea

Brachiopoda

Meristella sp.
Oriskania lucerna Schuchert
Spirifer arenosus (Conrad)
Spirifer murchisoni Castelnau
Stropheodonta sp.

Collection 51.

At end new highway bridge, opposite Welton.

Molluscoidea

Brachiopoda

Lingula sp.
Orbiculoidea sp.
Spirifer angularis Schuchert
Spirifer cumberlandiae Hall
Stropheodonta magniventra Hall.

Collection 101.

Ridgeley Member. 141 feet below top of Oriskany. 1.7 miles southeast of Durgon.

Molluscoidea

Brachiopoda

Anoplotheca flabellites (Conrad)
Chonetes hudsonicus Clarke
Leptaena rhomboidalis var. ventricosa Hall
Meristella lentiformis Clarke
Rensselaeria suessana var. immatura Schuchert
Spirifer angularis Schuchert
Spirifer angularis var. tribulis var. nov.
Spirifer cumberlandiae Hall
Spirifer intermedius Hall
Spirifer paucicostatus Schuchert
Spirifer tribuarius Schuchert and Maynard
Spirifer tribuarius var. pauciplicatus var. nov.
Schuchertella woolworthana (Hall)
Schuchertella cf. becraftensis (Clarke).

Mollusca

Pteropoda

Tentaculites elongatus Hall.

Collection 102.

Shriver Chert. 272 feet below top of Oriskany. 1.7 miles southeast of Durgon.

Molluscoidea

Brachiopoda

Anoplotheca dichotoma (Hall)
Leptaena rhomboidalis (Wilckens).

The following is a detailed section of the Oriskany just south of Kessel:

Kessel Section.

Marcellus Black Shale	
Oriskany	
Ridgeley Member	Feet.
Massive, coarse-grained, calcareous sandstone with many fossils: Spirifer arenosus, Rensselaeria sp., Hipparionyx proximus	5
More thin-bedded and lensic, calcareous sandstone and many Spirifer arenosus and Spirifer murchisoni	15
Concealed	10
Conglomerate with white quartz pebbles up to 3/4" in diameter	4
Rather thin-bedded, calcareous sandstone with an occasional fossil; Spirifer arenosus, Hipparionyx proximus, Bellerophon sp.	26
Massive sandstone with an occasional fossil: Rensselaeria sp. close to suessana, Spirifer arenosus, Platyceras gebhardi var. ventricosum crinoid stems	10
Conglomerate	3
Thin-bedded sandstone, partly concealed, numerous Spirifer arenosus	20
Very massive and resistant sandstone	5
Rather massive sandstone, four beds	7
Thin-bedded sandstone, some fossils	8
Massive sandstone with cavities 3" to 14" in diameter, fossils: Tentaculites elongatus, Spirifer murchi-rostrata	15
rostata	15
Concealed	4
Coarse sandstone, many cavities, picture of some about 1' diameter, fossils: Tentaculites elongatus, Rensselaeria sp. close to suessana	6
Ferruginous sandstone, many small brachiopods and Tentaculites, fossil collection 6: Spirifer perdewi, Spirifer arenosus, Spirifer cf. angularis, Spirifer cf. intermedius, Spirifer cf. cumberlandiae, Platyceras cf. gracile (Ridgeley fossils)	3
Shriver Chert Member.	
Dark-gray to blue, fine-grained arenaceous limestone with chert nodules, probably Shriver Chert	15
The fossils in the cherty portion of the Oriskany (Shriver Member) are few in comparison to those in the Ridgeley or upper sandy portion.	

DESCRIPTION OF PLATE LXV.—The row of knobs seen in the photograph is formed from the resistant Oriskany Sandstone and Chert and the New Scotland Chert combined. Where these formations have a steep dip, they usually form a narrow, high ridge, which, in many areas, is cut through by streams from the anticlinal side. This results, as in the picture, in a line of high, steep knobs, frequently spoken of as "Potato Knobs" or "Potato Hills," from their resemblance to rows of potato hills. Moorefield Valley, southwest of Bass.

PLATE LXV.—"Potato Knobs" in Oriskany Sandstone, Moorefield River Valley, southwest of Bass. (See page 294 for description of plate.)

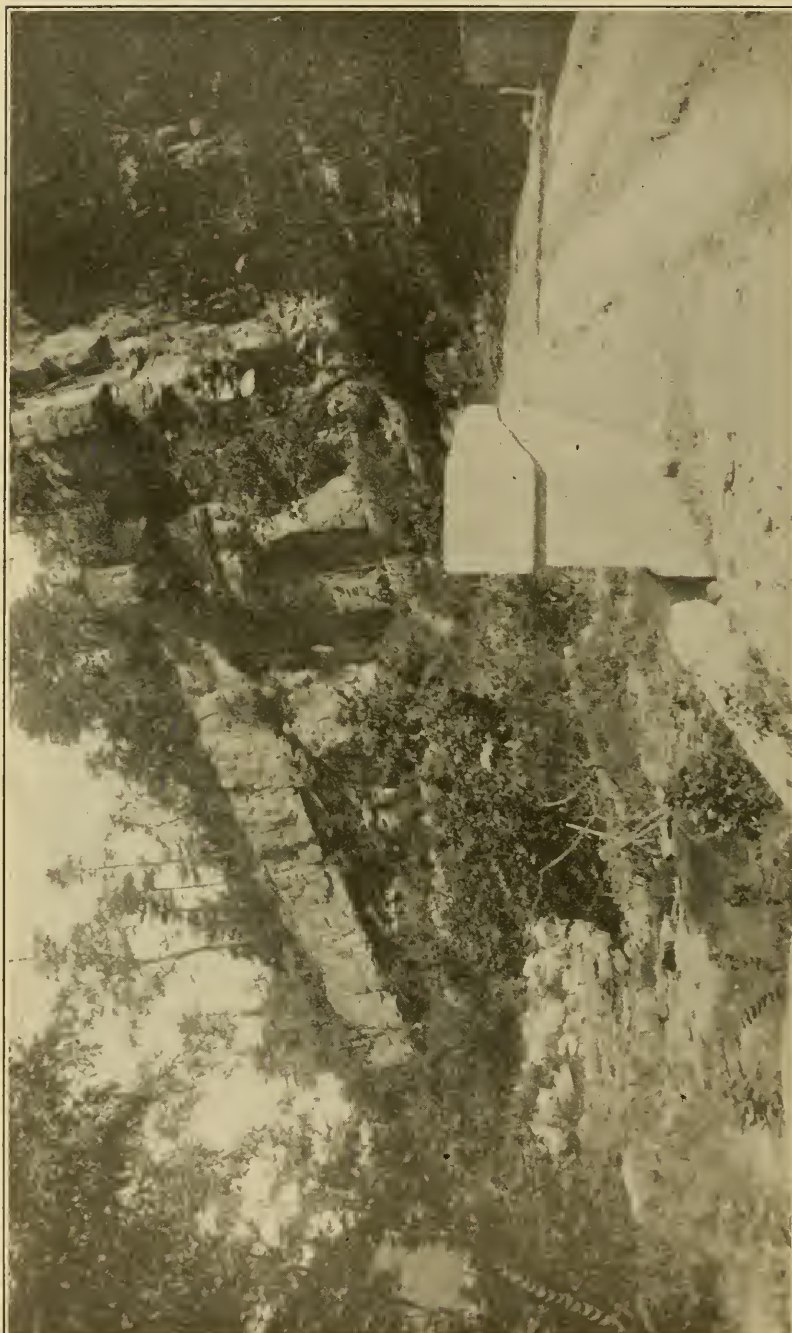


PLATE LXVI.—West limb of Oriskany Anticline (Broad Top—Stratford Ridge) at Reynolds Gap.

PLATE LXVII.—View of Falls over Oriskany Sandstone at Brake. The Falls are about 80 feet high in steps or series of falls 10 to 25 feet high with slopes (terraces) between.

PLATE LXVIII.—View of Oriskany Sandstone at north end of Sweedlin Hill at Hardy-Pendleton County line. Photo, taken from point in road just north of Wilson Run of Kettle Creek. Moorefield River is just back of cliff at right edge of picture.

Subdivisions.—Throughout the area of Hardy County there are two well-developed subdivisions of the Oriskany as is the case of the counties to the north and in the Maryland area, the upper coarse sandstone and the lower cherty and more calcareous sandstone. These have been named by the Maryland Geological Survey the Ridgeley and the Shriver, respectively. These subdivisions apply equally well in the Hardy County area. The three sections of the Oriskany given in this chapter show the characteristics of these subdivisions.

Economic Aspects.—The upper portion of the Oriskany frequently weathers into a very loose-grained, pure-quartz sandstone which shatters readily into a clean, white sand. This has been used in other areas for glass-sand. The residual soil from the Shriver Chert Member of the Oriskany, occurring usually on the ridges, makes unusually fine soil for fruit growing. Many of the Oriskany and New Scotland Chert ridges are being utilized as the sites for large peach and apple orchards.

A sample of the Oriskany Sandstone near Furnace was collected by Tucker for analysis by B. B. Kaplan, Chemist of the Survey, who makes the following report (Sample No. 21-T, Laboratory No. 2955):

	Per cent.
Silica (SiO_2)	96.10
Ferric Iron (Fe_2O_3)	0.88
Alumina (Al_2O_3)	1.12
Calcium Carbonate ($CaCO_3$)	1.33
Loss on Ignition	0.82
Total	100.25

Paul H. Price collected a sample of yellow clay (No. 3-PH, Laboratory No. 2935) from a point 4.5 miles south of Wardensville, apparently from near the horizon of the Oriskany Sandstone. Mr. B. B. Kaplan, Chemist of the Survey, reports the following results of an analysis of the sample:

	Per cent.
Silica (SiO_2)	58.60
Ferric Iron (Fe_2O_3)	6.81
Alumina (Al_2O_3)	21.71
Lime (CaO)	2.11
Magnesia (MgO)	2.41
Potassium (K_2O)	trace
Titanium (TiO_2)	trace
Loss on Ignition	8.00
Total	99.64

Fusing point in a reducing atmosphere 2515°.

It burns to a light red, and is suitable for a good quality brick, and for sewer pipe.

THE MIDDLE DEVONIAN.

This portion of the Devonian is composed almost entirely of shales, which in places reach a thickness of 1500 feet or more. The lower portion is largely a carbonaceous shale and the upper part a sandy shale. In both the lower and upper portions impure limestones and calcareous shales and concretions occur. In the upper portion are also thin beds of brownish and argillaceous sandstone. The outcrop of the Middle Devonian, similar to that of the Lower Devonian, is largely in either the eastern or in the western part of the county, the central portion being occupied by the Upper Devonian.

Practically all of the Middle Devonian rocks occupy comparatively low ground, the Moorefield and Wardensville Valleys being good examples.

The Middle Devonian is subdivided into two lithological as well as faunal units, which correspond to the Marcellus and and the Hamilton of New York. Locally, limestones in the lower portion of the Marcellus carry fossils strongly suggestive of Onondaga age, but many of the more typical Onondaga forms are lacking.

The Maryland Geological Survey places all the rocks in the Middle Devonian under the name Romney but recognizes the subdivisions Onondaga, Marcellus, and Hamilton. This grouping of the Middle Devonian simplifies greatly the mapping, since it is extremely difficult to draw exact lines between the Marcellus and the Hamilton in areas where the rock is of low dip. The upper and lower limits of the Lower Devonian are well defined.

MARCELLUS SERIES.

This series of rocks is composed for the most part of black, fissile shale, which becomes flaky and easily slickensided and thinned by compression, so that on the west limbs of the anticlinal folds, where these rocks outcrop with nearly vertical dip, the thickness is frequently considerably reduced. These shales are so black and have such a high carbon content that they have been frequently prospected for coal. Like most highly carbonaceous shale, they have a tendency to weather light-colored. The soil from these shales is a light-colored to buff, clay soil, which ruts badly, and is hard to travel over in wet weather. This is markedly different from soil of the Hamilton, which is sandy and therefore fine for road construction. Toward the base of the Marcellus there is, in most localities, a calcareous portion. This is usually in two divisions separated by shale, but in some localities there are several beds of alternating impure limestone and shale as

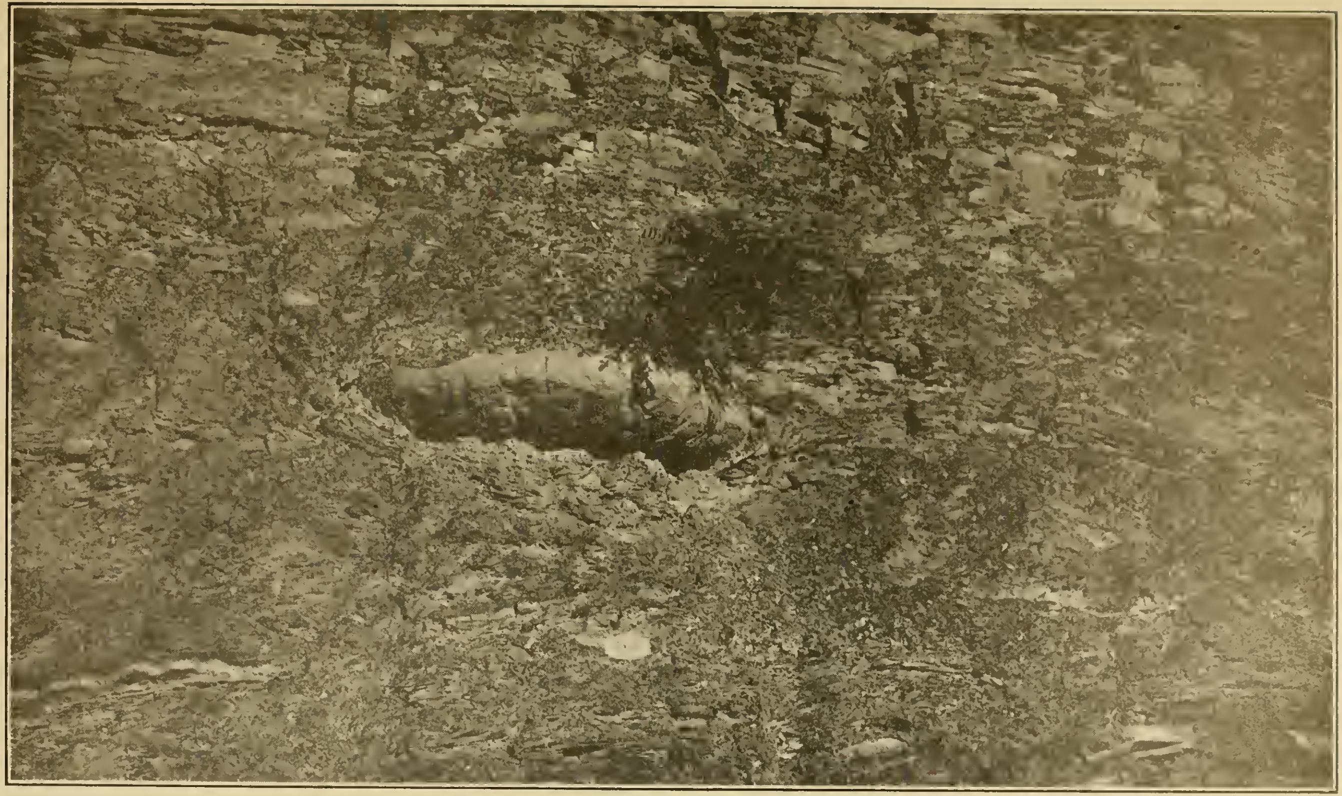


PLATE LXIX.—A large concretion in the lower portion of the Marcellus Shale. Moorefield-Romney road, ½ mile northeast of Old Fields.

seen in sections, pages 302 and 303. In many localities large concretionary and septarian nodules of ferruginous and calcareous character are common in the dark shales immediately overlying the Oriskany.

The following are sections of portions of the Marcellus, usually the lower portion:

Rough Section Selinsgrove Limestone at Fossil Locality No. 20, 0.5 Mile West of Old Fields.

Black shale with Styliolina fissurella in abundance, Marcellus	
Selinsgrove	Feet.
Calcareous sandstone and semicrystalline limestone, hackly weathering, many Ambocoelia umbonata	15
Green to gray calcareous shale	15
More limy shale with many fossils:	
Ambocoelia umbonata Conrad	
Leptaenisca australis Kindle	
Phacops cristata var. pipa Hall	
Atrypa reticularis (Linne)	
Anoplotheca (Coelospira) acutiplicata (Conrad)	
Striatopora sp.	
(Probably Onondaga in age)	30
Concealed	

Section Selinsgrove Limestone 2.5 Miles Southeast of Moorefield Where Elkhorn Mountain is Cut by Moorefield River.

	Feet.
Black shale of Marcellus	
Dark-gray rather impure limestone	85
Very black and very much crushed shale	30
Dark-gray, impure rather shaly limestone with 1-foot layer made up almost entirely of Ambocoelia umbonata about 20 feet below the top and many concretionary bryozoa or cup corals from 30 to 50 feet from the top	100
Black shale of Marcellus	

Section Selinsgrove Limestone, Powderlick School.

	Feet.
Black shale	
Impure limestone	30
Calcareous shale	15
Impure limestone	10
Calcareous shale	25
Impure limestone	8
Calcareous shale	7
Impure limestone	5
Black shale	

Section Selinsgrove Limestone, Moorefield-Reynolds Gap Road, 1.2 Miles North of Old Fields.

	Feet
Massive, dark, bluish-gray, impure limestone with conchoidal fracture and few fossils	20
Same as above but with many small (1" to 4") calcareous and ferruginous concretions	3
Massive, impure limestone, many masses of spherical-shaped small concretions of pyrite and calcium carbonate (Fossil Collection No. 27 with a number of Onondaga forms)	8
Gray calcareous shale	7
More massive, arenaceous, and calcareous shale	4
Shaly limestone	3
Compact, grayish-blue, impure, brown-weathering limestone, like top layer	20
Concealed, 20' to	40
Black shale of Marcellus	

Thickness.—The Marcellus varies considerably in thickness, from about 500 to 800 feet. It is impossible to get the exact thickness in any of the places visited, because of the repetition of beds by minor folding, or thinning due to lateral compression.

Topography.—With the exception of the lower portion of the Genesee Shales the Marcellus is the most easily eroded series of rocks exposed in Hardy County. The larger flat-land areas of the Moorefield valley and the Wardensville valley are largely formed in Marcellus Shale. These bottom lands are frequenty largely covered by alluvial material. Along the Marcellus-Hamilton line in areas of comparatively steep dipping beds, the Hamilton outcrop is usually considerably higher than that of the Marcellus.

Areal Extent.—In the eastern part of the county the Marcellus is confined to the central area of the Wardensville Syncline and to the border area of the small syncline to the east of Wardensville.

From Lost City to Baker in the Lost River Valley the course of the stream is largely in the Marcellus outcrop, but to the northeast of Baker and to the southwest of Lost City the Marcellus rises on the east slope of the valley and the stream is more confined to the Genesee outcrop. The great Moorefield valley is formed largely in the Marcellus and the Hamilton. In places these two shales alternate in their outcrop due to minor folding. In a direction due north from Moorefield the surface rock is either alluvial or Marcellus for a distance of eight miles. A northwest-southeast line passing through Old Fields shows a width of outcrop of the Marcellus of about 6 miles. The valleys to the north and to the south of the cross-section are largely Marcellus though there are many larger or smaller anticlinal ridges of Oriskany Sand-

PLATE LXX.—Marcellus Black Shale on west side of Moorefield River, about 2½ miles southeast of Moorefield where river bends to northeastward.

stone rising above the Oriskany shale flat lands. There are a number of small Marcellus outcrops in the Oriskany Sandstone areas in various parts of the county. These represent local synclinal basins in the Oriskany.

Contacts.—The lower contact of the Marcellus is clearly drawn. The coarse sandstone of the Oriskany, with its abundant marine life, gives place to the black and dark-gray, argillaceous and carbonaceous shales of the Marcellus, which contain a dwarf pelecypod and pteropod fauna, more characteristic of lagoon conditions. The upper contact with the Hamilton is much more difficult to draw. There are locally, in the Hamilton, beds of dark-gray and black shale much resembling the Marcellus. The basal Hamilton is apt to have a greater number of calcareous and ferruginous concretions than the top of the Marcellus. The Hamilton is also arenaceous with a brown-weathering character and with marine fossils common. There are in many places calcareous beds toward the base of the Hamilton which much resemble the Selinsgrove Limestone toward the base of the Marcellus. This has led to some confusion. Such calcareous beds are, however, quite fossiliferous and their Hamilton character is clearly shown. The exposure of such a limestone bed is to be seen one mile south of Moorefield in a cut just east of the Moorefield-Petersburg highway where it crosses the Baltimore & Ohio Railroad.

Fossils.—Outside of the fossils occurring in the calcareous layers in the Marcellus, the life forms represented are limited to a few species. Styliolina fissurella is the most common. Liorhynchus limitare and a few other forms occur sparingly.

The calcareous beds are confined to the lower portion of the Marcellus. These beds are usually fossiliferous and carry locally a number of forms of Onondaga character. Collection No. 20 from cut along highway one-half mile west of Old Fields has the following species:

Collection 20.

Onondaga? Member. On road 0.5 mile northwest of Old Fields.

Coelenterata
- Cup coral sp.

Echinodermata
- Arm of starfish?

Molluscoidea
- **Bryozoa**
  - Striatopora cf. cavernosa
- **Brachiopoda**
  - Ambocoelia umbonata Conrad
  - Anoplotheca (Coelospira) acutiplicata Conrad
  - Atrypa reticularis (Linne)
  - Leptaenisca australis Kindle

Arthropoda
- Phacops cristata var. pipa Hall.

PLATE LXXI.—The smaller concretionary-looking portions of the rock are more or less spherical-shaped Bryozoa and concretions of Pyrite. A number of Onondaga forms came from this layer. One mile northeast of Old Fields, Romney-Moorefield road.

Three of the above are Onondaga forms. There is usually present in the lower of the two calcareous horizons in the lower Marcellus a thin portion of the limestone which is almost entirely made up of the fossil remains of Ambocoelia umbonata.

Collection 27.

Onondaga?. On Moorefield-Romney pike, 1.25 miles northeast of Old Fields.

Mollusca
  Cephalopoda
    Orthoceras sp.

Subdivisions.—The Marcellus can be subdivided into an upper shaly portion and a lower calcareous and shaly portion. The lower division is less constant in its character than the upper and is itself usually subdivided into an upper calcareous, an upper shale, a lower calcareous, and a lower shale. This lower shale overlies the Oriskany and frequently carries concretions, as seen in Plate LXXI. The calcareous beds are sometimes subdivided into several layers intercalated with shales as in section at Powderlick School, page 302.

It seems to the writer that the Onondaga species mingled with other forms of Marcellus character points to restricted sea conditions in the West Virginia area during late Onondaga and early Marcellus time. In this area occur a few migrant Onondaga species but the more characteristic New York forms such as the Agoniatites expansus and the corals are not conspicuous. It is more logical to think of the lower or Selinsgrove portion of the Marcellus as of Marcellus age, but having a few superannuated migrant fossils of the Onondaga from bordering sea areas.

Economic Aspects.—The Marcellus Black Shale breaks down into a plastic clay soil, which is very retentive of water and hard to travel in wet weather. Where the shales have a lime content they form excellent agricultural soils. The better farm lands about Moorefield and Wardensville are located in these shales or in alluvial soils over the shales.

The Marcellus Shales could be used for brick-making. The better ones for this purpose are found toward the upper part of the formation close to the contact with the Hamilton, for here there is a tendency for the shales to be more arenaceous and to have less shrinkage. This might also be used as a mix in the manufacture of Portland cement.

Locally the black shales have very high carbon content and may carry a considerable amount of kerogen. There has been no prospecting for oil shales in the county so far as known. The Selinsgrove Limestone is usually quite impure.

It could be used as a mix with purer limestone in the manufacture of Portland cement, but with the abundance of better grade limestone in most areas near its outcrop, it would find no commercial uses.

The analysis of a sample of black, fossiliferous limestone (Selinsgrove?) from about the center of the lower black shale (Marcellus) collected by Tucker (Sample No. 2-T, Laboratory No. 2947) 2 miles up Moorefield River from bridge at upper end of Moorefield, shows as follows as reported by B. B. Kaplan, Chemist of the Survey:

	Per cent.
Silica (SiO_2)	3.50
Ferric Iron (Fe_2O_3)	0.83
Alumina (Al_2O_3)	0.77
Calcium Carbonate ($CaCO_3$)	93.25
Magnesium Carbonate ($MgCO_3$)	0.68
Phosphoric Acid (P_2O_5)	0.025
Loss on Ignition	1.15
Total	100.205

On the lands of **C. E. Cowger,** 1.8 miles southwest of Brake, just above county road at elevation of 1135 feet (1105 marked on map), there is a deposit of finely powdered marl, about 40 feet long by 5 to 8 feet thick, occurring in the Marcellus Shale near its contact with the Oriskany. Tucker collected a sample (No. 8-T, Laboratory No. 2941) of this material for analysis by B. B. Kaplan, Chemist of the Survey, who reports the following results:

	Per cent.
Silica (SiO_2)	4.60
Ferric Iron (Fe_2O_3) and Alumina (Al_2O_3)	1.00
Calcium Carbonate ($CaCO_3$)	91.20
Magnesium Carbonate ($MgCO_3$)	1.20
Phosphoric Acid (P_2O_5)	trace
Loss on Ignition	1.85
Total	99.85

A sample (No. 15-T, Laboratory No. 2939) of **gypsum** crystals mixed with shale and clay on the lands of **P. F. Sions** 1.5 miles northwest of Reynolds Gap, at an elevation of 950 feet, was collected by Tucker in the Marcellus Shale near the contact of the Hamilton. The analysis of this sample by B. B. Kaplan, Chemist of the Survey, is as follows:

	Per cent.
Silica (SiO_2)	2.80
Ferric Iron (Fe_2O_3)	0.23
Alumina (Al_2O_3)	0.45
Calcium Sulphate ($CaSO_4.2H_2O$)	96.25
Total	99.73

This deposit of gypsum crystals is not very extensive but is mixed with the shale and clay in the bottom lands along the sides of a small branch of Mudlick Run. The sample (15-T) contained only the crystals.

A sample of the shale exposed along this small stream on the lands of P. F. Sions at the same location as the gypsum crystals shows the following on analysis by B. B. Kaplan, Chemist of the Survey (Sample No. 16-T, Laboratory No. 2950). Some gypsum crystals were embedded in this shale, as will be noted from the analysis:

	Per cent.
Silica (SiO_2)	48.15
Ferric Iron (Fe_2O_3)	5.97
Alumina (Al_2O_3)	16.50
Calcium Sulphate ($CaSO_4$)	13.75
Loss on Ignition	16.00
Total	100.37

Paul H. Price collected a sample (No. 3-PH, Laboratory No. 2943) of supposed manganese ore from the farm of Mrs. M. Y. Stewart west of Wardensville, which would apparently place the horizon in the Marcellus Shale. Mr. B. B. Kaplan, Chemist of the Survey, reports as follows: "This sample was colored to resemble a manganese ore. However, this coloring was due to organic matter. The sample contained 10.2 per cent. organic matter. The residue was insoluble in acid. It was nothing but sand."

HAMILTON.

The Hamilton is composed very largely of arenaceous shale with occasional sandstone beds. Toward the base the shales become more argillaceous and carbonaceous, resembling considerably the Marcellus Shales below. Throughout the Hamilton there occur locally beds and lenses of calcareous nature which carry many marine fossils. These shales are usually dark-gray in the fresh exposures but generally weather to a chocolate-brown or brownish-buff. The sandstones are usually a greenish-gray before weathering and weather to a reddish-brown. The sandstones are coarse textured and seldom flaggy. The more arenaceous beds weather with concretionary structure. Both the shales and the sandstones have a tendency to break into long rectangular pieces called "pencil weathering". The lower or more carbonaceous shales weather gray like the Marcellus below. Toward the base of the Hamilton in many localities there are many concretions and near the top in most localities there is a very calcareous bed which carries a prolific brachiopod fauna.

Thickness.—The Hamilton is on the average about 450 feet thick but differs considerably in different sections. At Baker School in the eastern part of the county it is about 500 feet. About a mile northeast of Moorefield a measured section gives the thickness of Hamilton as about 435 feet.

Topography.—In its outcrop the Hamilton is usually associated with the Marcellus Shale. It is, however, more resistant to erosion than the Marcellus and as a result occupies slightly higher ground in its outcrop. Both these formations in Hardy County outcrop either in valleys or on the lower portions of the slopes.

Areal Extent.—The only outcrop of the Hamilton in the eastern part of the county is in the small syncline (Meadow Branch) just to the east of Wardensville. There is a continuous outcrop of the Hamilton from Rockingham County, Virginia, on the south, to Hampshire County on the north along the east side of Lost River Valley. The central portion of the county is without Hamilton outcrop. The chief outcrops are in the Moorefield Valleys about Elkhorn Mountain Anticline, the Middle Mountain ("Trough") Syncline, and the Clearville Syncline. Besides these larger outcrops there are a number of small areas of outcrop where local synclines in the Marcellus bring the Hamilton-Marcellus contact below the level of the Marcellus outcrop.

Contacts.—The lower contact of the Hamilton with the Marcellus is very difficult to draw since there are beds of shale in the lower portion of the Hamilton which are almost identical in lithological character with the ones in the upper portion of the Marcellus. The line is drawn where the arenaceous shales come in above the more argillaceous and carbonaceous shales of the Marcellus. The Hamilton deposits weather with a red to brown color and yield loam soils while the Marcellus weathers gray and yields a clay soil. There is a decided difference in the fossils in the Hamilton and the Marcellus and this is the best guide in their separation. The Hamilton has an abundance of marine fossils, especially brachiopods, while the upper Marcellus fauna is scanty and dwarf in character.

The upper contact of the Hamilton is rather clearly defined, for the highly fossiliferous and brown-weathering arenaceous shales and impure limestone of the Hamilton give place to the black, fissile, and only slightly fossiliferous, carbonaceous shales of the Genesee. The Hamilton Formation must have been put down in marine waters while the Genesee beds were deposited under conditions where it was very difficult for marine forms to exist such as might be found in lagoons and sounds but slightly connected with the sea.

Fossils.—The Hamilton fossils are entirely of marine character and in certain horizons are very prolific as near the top and near the bottom. The more highly fossiliferous beds are calcareous, the one at the top being especially high in its lime content.

The fossils from the top portion are listed below, collections Nos. 37, 38A, 40, 41, and 42:

Collection 37.

Upper. By branch, north of highway, about 1/2 mile northeast of Moorefield.

Echinodermata
- Crinoid stem sp.

Molluscoidea
- **Bryozoa**
  - Fenestella sp.
- **Brachiopoda**
  - Ambocoelia umbonata Conrad
  - Athyris spiriferoides (Eaton)
  - Atrypa aspera Hall
  - Atrypa reticularis (Linne)
  - Atrypa spinosa Hall
  - Chonetes sp.
  - Lingula sp.
  - Spirifer audaculus (Conrad)
  - Spirifer consobrinus var. variplicatus var. nov.
  - Spirifer sp.
  - Stropheodonta inaequistriata (Conrad)
  - Tropidoleptus carinatus (Conrad)

Mollusca
- **Pelecypoda**
  - Palaeoneilo sp.
- **Gastropoda**
  - Cyclonema sp.
  - Loxonema hamiltoniae Hall
- **Pteropoda**
  - Tentaculites cf. bellulus Hall

Arthropoda
- Phacops rana (Green).

Collection 38A.

Top. By branch, north of highway, about 1/2 mile northeast of Moorefield.

Echinodermata
- Crinoid stem sp.

Molluscoidea
- **Brachiopoda**
  - Atrypa aspera Hall
  - Chonetes sp.
  - Spirifer mucronatus (Conrad)
  - Stropheodonta inaequistriata (Conrad)

Mollusca
- **Gastropoda**
  - Bellerophon sp.

Arthropoda
- Phacops rana (Green).

Collection 40.

Top. On second-class road by Old Pine Church.

Coelenterata
Stereolasma rectum Hall
Echinodermata
Crinoid stem sp.
Molluscoidea
Bryozoa
Fenestella sp.
Brachiopoda
Athyris spiriferoides (Eaton)
Atrypa spinosa Hall
Camarotoechia sp.
Chonetes sp.
Productella sp.
Rhipidomella sp.
Spirifer angustus Hall
Spirifer audaculus (Conrad)
Spirifer consobrinus var. variplicatus var. nov.
Spirifer fimbriatus Conrad
Spirifer granulosus (Conrad)
Spirifer mucronatus (Conrad)
Stropheodonta inaequistriata (Conrad)
Stropheodonta sp.
Tropidoleptus carinatus (Conrad)
Mollusca
Pelecypoda
Actinopteria sp.
Gastropoda
Diaphorostoma lineatum (Conrad)
Platyceras sp.
Cephalopoda
Orthoceras coelamen Hall
Arthropoda
Proetus macrocephalus Hall.

Collection 41.

Top. By forks of second-class road along stream in Williams Hollow.

Coelenterata
Stereolasma rectum Hall
Molluscoidea
Brachiopoda
Athyris spiriferoides (Eaton)
Atrypa aspera Hall
Camarotoechia congregata (Conrad)
Lingula aff. delia Hall
Spirifer audaculus (Conrad)
Stropheodonta sp.
Tropidoleptus carinatus (Conrad)
Mollusca
Pelecypoda
Actinopteria sp. .
Arthropoda
Homalonotus dekayi (Green)
Phacops rana (Green).

Collection 42.

Upper. On second-class road, 1/2 mile southeast of Mapleton.

Coelenterata
- Stereolasma rectum Hall

Echinodermata
- Crinoid stem sp.

Molluscoidea
- **Bryozoa**
  - Fenestella sp.
- **Brachiopoda**
  - Ambocoelia umbonata Conrad
  - Atrypa aspera Hall
  - Camarotoechia sp.
  - Chonetes sp.
  - Reticularia fimbriata (Conrad)
  - Spirifer audaculus (Conrad)
  - Spirifer consobrinus (d'Orbigny)
  - Spirifer mucronatus (Conrad)
  - Schuchertella sp.
  - Tropidoleptus carinatus (Conrad)

Mollusca
- **Gastropoda**
  - Pleurotomaria sp.

Arthropoda
- Homalonotus dekay; Green
- Phacops rana (Green).

The following fossils occur in the limestone beds near the base of the Hamilton from collections Nos. 3, 4, 7, 8, and 28. Identifications of collections Nos. 3, 4, 7, and 8 made by Dr. Joel H. Swartz:

Collection 3.

On main road 0.8 mile northwest of Fisher P. O.

Coelenterata
- Cladochonus sp.

Molluscoidea
- **Bryozoa**
  - Cystodictya incisurata Hall
- **Brachiopoda**
  - Ambocoelia umbonata (Conrad)
  - Ambocoelia spinulosa Hall
  - Athyris spiriferoides (Eaton)
  - Athyris cora Hall
  - Atrypa reticularis (Linne)
  - Atrypa spinosa Hall
  - Camarotoechia prolifica Hall
  - Chonetes gibbosus sp. nov.
  - Chonetes cf. hemispherica
  - Chonetes mucronatus Hall
  - Chonetes setiger (Hall)
  - Chonetes vicinus (Castelnau)
  - Cyrtina hamiltonensis Hall
  - Eunella lincklaeni Hall
  - Liorhynchus cf. laura (Billings)

Meristella barrisi Hall
Meristella haskinsi Hall
Productella cf. spinulicosta Hall
Reticularia fimbriata (Conrad)
Spirifer angustus Hall
Spirifer audaculus (Conrad)
Spirifer consobrinus (d'Orbigny)
Spirifer consobrinus var. variplicatus var. nov.
Spirifer granulosus (Conrad)
Spirifer mucronatus (Conrad)
Spirifer cf. mucronatus (Conrad)
Spirifer cf. sculptilis Hall
Schuchertella variabilis Prosser
Stropheodonta inaequistriata (Conrad)

Mollusca

Pelecypoda

Actinopteria aff. decussata Hall
Palaeoneilo cf. maxima (Conrad)

Gastropoda

Cyclonema sp.

Vermes

Cornulites sp.

Arthropoda

Homalonotus dekayi (Green)
Phacops rana (Green).

Collection 4.

On main road, 0.8 mile northwest of Fisher P. O., and 300 feet northwest of Locality No. 3.

Molluscoidea

Brachiopoda

Ambocoelia umbonata Conrad
Athyris spiriferoides (Eaton)
Athyris cora Hall
Athyris sp.
Atrypa reticularis (Linne)
Chonetes mucronatus Hall
Chonetes sp.
Dalmanella sp.
Eunella lincklaeni Hall
Meristella cf. laevis Vanuxem
Rhipidomella cyclas Hall
Rhipidomella aff. tullius Hall
Rhipidomella sp.
Spirifer angustus Hall
Spirifer audaculus (Conrad)
Spirifer consobrinus (d'Orbigny)
Spirifer mucronatus (Conrad)
Schuchertella variabilis Prosser
Stropheodonta inaequistriata (Conrad)
Stropheodonta perplana (Conrad)
Stropheodonta striatula (Schlotheim)
Stropheodonta textilis Hall
Tropidoleptus carinatus (Conrad)

Mollusca

Pelecypoda

Grammysia cf. arcuata Hall

Gastropoda

Loxonema hamiltoniae Hall

Arthropoda

Phacops rana (Green).

Collection 7.

500 feet northeast of Locality 16, about 1.25 miles northwest of Moorefield.

Coelenterata

Cladochonus sp.

Molluscoidea

Brachiopoda

Ambocoelia umbonata Conrad
Ambocoelia spinulosa Hall
Atrypa reticularis (Linne)?
Camaratoechia prolifica Hall
Chonetes vicinus (Castelnau)
Eunella lincklaeni Hall
Meristella sp. ?
Nucula corbuliformis Hall
Reticularia fimbriata (Conrad)
Spirifer audaculus (Conrad)
Spirifer consobrinus (d'Orbigny)
Spirifer mucronatus (Conrad)
Spirifer cf. sculptilis Hall
Schuchertella variabilis Prosser
Tropidoleptus carinatus (Conrad)
Vitulina pustulosa Hall

Mollusca

Pelecypoda

Buchiola halli Clarke
Cypricardinia indenta (Conrad)
Leda proutyi Swartz sp. nov.
Orthonota parvula Hall
Paracyclas sp.

Gastropoda

Loxonema hamiltoniae Hall
Pleurotomaria capillaria Conrad
Pleurotomaria itys Hall

Cephalopoda

Orthoceras constrictum (Vanuxem)
Orthoceras subulatum Hall
Orthoceras cf. subulatum Hall
Orthoceras sp.

Arthropoda

Fish scale
Dignomia alveata Hall.

Collection 8.

1000 feet north of Locality 7, on River road, about 1.45 miles northwest of Moorefield.

Molluscoidea
- Brachiopoda
  - Ambocoelia umbonata Conrad
  - Meristella barrisi Hall
  - Spirifer consobrinus var. variplicatus var. nov.
  - Schuchertella variabilis Prosser

Mollusca
- Gastropoda
  - Loxonema hamiltoniae Hall
  - Loxonema delphicola Hall
  - Platyceras sp.
  - Platyceras cf. carinatus

Arthropoda
  - Phacops rana (Green).

Collection 28.

Basal. Cut by railroad and highway, 1 mile southwest of Moorefield.

Coelenterata
  - Stereolasma rectum Hall

Molluscoidea
- Brachiopoda
  - Ambocoelia umbonata Conrad
  - Chonetes sp.
  - Meristella sp.
  - Spirifer sculptilis (Hall)

Mollusca
- Gastropoda
  - Cyclonema cf. hamiltoniae Hall
  - Diaphorostoma lineatum (Conrad)
  - Loxonema hamiltoniae Hall
- Cephalopoda
  - Orthoceras sp.

Arthropoda
  - Phacops rana (Green).

Additional collections from the Hamilton were made at fossil localities 1 (lower), 2, 15, 16, 17, 18, 19, 29 (?), 33, 35, 36, 49 (upper), and 50 (upper), as follows:

Collection 1.

3/4 mile northeast of Moorefield. (Lower Hamilton).

Coelenterata
  - Stereolasma rectum Hall

Molluscoidea
- Brachiopoda
  - Athyris spiriferoides (Eaton)
  - Cyrtina hamiltonensis Hall
  - Rhipidomella cf. leucosia Hall
  - Spirifer audaculus (Conrad)
  - Spirifer consobrinus (d'Orbigny).

Collection 2.

On road over hill, 1.5 miles southwest of Taylor.

Coelenterata
- Cladochonus sp.
- Michelina stylopora Eaton
- Michelina sp.

Molluscoidea
- **Bryozoa**
  - Cystodictya incisurata Hall
- **Brachiopoda**
  - Ambocoelia umbonata Conrad
  - Athyris spiriferoides (Eaton)
  - Atrypa reticularis (Linne)
  - Chonetes scitulus Hall
  - Cyrtina hamiltonensis Hall
  - Meristella barrisi Hall
  - Meristella haskinsi Hall
  - Meristella cf. haskinsi Hall
  - Nucula corbuliformis Hall
  - Reticularia fimbriata (Conrad)
  - Spirifer consobrinus var. variplicatus var. nov.
  - Spirifer mucronatus (Conrad)
  - Spirifer sculptilis Hall
  - Schuchertella variabilis Prosser
  - Stropheodonta inaequistriata (Conrad)

Mollusca
- **Pelecypoda**
  - Palaeoneilo sp.
  - Leptodesma rogersi Hall
  - cf. Leptodesma rogersi Hall
- **Gastropoda**
  - Cyclonema minuta sp. nov.
  - Loxonema hamiltoniae Hall
  - Loxonema cf. hamiltoniae Hall
  - Platyceras minutum sp. nov.
  - Pleurotomaria itys Hall
  - Pleurotomaria sp.

Arthropoda
- Homalonotus dekayi (Green)
- Dalmanites boothi (Green).

Collection 15.

Along road west of South Branch, 1.25 miles northwest from Moorefield.

Molluscoidea
- **Brachiopoda**
  - Ambocoelia umbonata Conrad
  - Athyris spiriferoides (Eaton)
  - Atrypa reticularis (Linne)
  - Meristella barrisi Hall
  - Spirifer consobrinus (d'Orbigny)
  - Stropheodonta inaequistriata (Conrad)

Mollusca
- **Gastropoda**
  - Cyclonema hamiltoniae Hall

Arthropoda
- Homalonotus dekayi (Green) ?

Collection 16.

Just below Locality 15, near bend in road, 1.25 miles northwest of Moorefield.

Molluscoidea
- Brachiopoda
  - Ambocoelia umbonata Hall
  - Camarotoechia prolifica Hall
  - Chonetes lepidus Hall.

Collection 17.

From bluff just northeast of forks of road 1.5 miles northwest of Moorefield.

Coelenterata
- Stereolasma rectum Hall

Molluscoidea
- Brachiopoda
  - Chonetes lepidus Hall
  - Meristella barrisi Hall
  - Spirifer consobrinus var. variplicatus var. nov.
  - Schuchertella variabilis Prosser
  - Stropheodonta inaequistriata (Conrad)

Mollusca
- Gastropoda
  - Loxonema sp.
  - Pleurotomaria itys Hall.

Collection 18.

On highway, 2 miles northwest of Moorefield.

Echinodermata
- Crinoid stem sp.

Molluscoidea
- Brachiopoda
  - Ambocoelia umbonata Conrad
  - Spirifer consobrinus var. variplicatus var. nov.
  - Spirifer fimbriatus Conrad
  - Schuchertella sp.

Mollusca
- Gastropoda
  - Murchisonia sp.
- Pteropoda
  - Conularia sp.
- Cephalopoda
  - Orthoceras cf. subulatum Hall

Vermes
- Worm boring.

Collection 19.

On highway, 2.25 miles northwest of Moorefield.

Coelenterata
- Stereolasma rectum Hall

Molluscoidea
- Brachiopoda
  - Centronella cf. ovata Hall
  - Schuchertella sp.
  - Spirifer sp.

Mollusca
  Pelecypoda
    Actinopteria aff. decussata Hall
  Gastropoda
    Cyclonema cf. hamiltoniae Hall
  Pteropoda
    Styliolina fissurella (Hall).

Collection 29.

0.4 mile west of Fisher.

Molluscoidea
  Brachiopoda
    Ambocoelia umbonata Conrad
    Productella sp.
Mollusca
  Pteropoda
    Styliolina fissurella (Hall).

Collection 33.

3 miles west of Pancake, Hampshire County.

Molluscoidea
  Brachiopoda
    Tropidoleptus carinatus (Conrad)
Mollusca
  Gastropoda
    Pleurotomaria sp.

Collection 35.

On second-class road, 3 miles southwest of Moorefield.

Echinodermata
    Crinoid stem sp.
Molluscoidea
  Brachiopoda
    Ambocoelia umbonata Conrad
    Chonetes sp.
    Dalmanella sp.
    Meristella sp.
    Spirifer sp.
Mollusca
  Gastropoda
    Bellerophon sp.
    Loxonema sp.

Collection 36.

Moorefield-Petersburg road, 2.5 miles southwest of Moorefield.

Molluscoidea
  Brachiopoda
    Ambocoelia umbonata Conrad
    Athyris spiriferoides (Eaton)
    Atrypa aspera Hall
    Chonetes sp.
    Orthis cf. lepidus Hall
    Spirifer audaculus (Conrad)
    Spirifer mucronatus (Conrad)
    Schuchertella sp.
    Stropheodonta textilis Hall.

Collection 49.

Upper. On second-class road, west slope Elkhorn Mountain, 1.25 miles southeast of Durgon.

Molluscoidea
- **Brachiopoda**
  - Ambocoelia umbonata Conrad
  - Atrypa aspera Hall
  - Chonetes sp.
  - Spirifer audaculus (Conrad)
  - Spirifer consobrinus var. variplicatus var. nov.
  - Spirifer mucronatus (Conrad)
  - Schuchertella sp.

Collection 50.

Upper. Moorefield-Petersburg road, about 0.6 mile east from Oakdale (Rig P. O.)

Echinodermata
- Crinoid stem sp.
- Pentremitidae sp.

Molluscoidea
- **Brachiopoda**
  - Liorhynchus cf. laura (Billings)
  - Rhipidomella cf. leucosia Hall

Arthropoda
- Phacops rana (Green).

Subdivisions.—The main portion of the Hamilton is arenaceous shale with occasional more sandy beds and some calcareous layers all weathering to a brown color. The lower portion of the Hamilton in many places has a considerable development of dark-colored and sparingly fossiliferous shales which much resemble the Marcellus. Were it not for the occasional limestone lens in this portion which carries Hamilton forms these beds would be more logically correlated with the Marcellus.

Economic Conditions.—The chief use to be made of the Hamilton rocks is for road building. There is probably no better natural shale for the construction of light-traffic roads than the Hamilton arenaceous shales. They contain the right mixture of sand and clay and the binding material in the form of lime or iron or both.

UPPER DEVONIAN.

This division contains the following subdivisions:

Upper Devonian {
- Catskill
- Chemung
- Portage
- Genesee.

Of the total thickness of rocks exposed in Hardy County of about 14,000 feet, the Upper Devonian makes up about 8,000 feet. These rocks are composed entirely of shales and sandstones. The sandstones increase toward the top as do also the red beds which mark non-marine deposition and a corresponding decrease in the fossil content of the beds.

Outside of the small areas in the syncline to the east of Wardensville and the Clearville Syncline to the north of Moorefield, the Upper Devonian rocks are confined in their outcrop to the central belt of the county, east of the Moorefield valley and west of the Lost City valley. This area is a little more than a third of the county. The higher formations in the Upper Devonian occur at or toward the center of the large synclines in this area and the lower divisions of the Upper Devonian outcrop on the flanks of these larger synclines or along the areas of the anticlines.

The Upper Devonian is separated from the Middle Devonian by an unconformity which is shown by the fact that the dark shales of the Genesee are extremely variable in their thickness in the various sections seen. In some localities the less carbonaceous and sandy beds appear to rest upon the Hamilton while in others there is a thickness of about 160 feet or more of the black argillaceous shales intervening. The line between the Devonian and the Mississippian is less obvious. There seem to be transitional conditions. The line is drawn where the red sandstones and shales give place to lighter-colored quartzitic sandstones and conglomerates with some plant remains scattered through them.

GENESEE FORMATION.

The Genesee is made up of black argillaceous shales below, followed above by black but more arenaceous beds. These give way to greenish-gray arenaceous shale rather platy and slightly darker arenaceous shales with occasional thin sandstone bands. The upper and more arenaceous portion is generally thicker than the lower and more argillaceous portion. The thickness of the Genesee varies much in different sections but is generally from 100 to 400 feet. This thickness includes more of the upper arenaceous shales than is done by Reger in the Mineral and Grant Report. This is based on carefully studied sections and collections.

Topography.—The lower portion of the Genesee is the most easily eroded formation outcropping in Hardy County, the upper portion being more resistant, so that the lower portion is usually to be found in a comparatively narrow valley between the more resistant sandy shales of the Hamilton below and the platy shales of the upper portion of the Genesee.

In the same way the top of the Genesee is topographically lower than the overlying Portage which carries sandstones of much greater thickness than the Genesee. Since the large valleys in the county are made from the Marcellus and the Hamilton in large part, the Genesee outcrop forms a minor valley on the slopes of the more resistant and younger formations.

Areal Extent.—The thickness of the Genesee is so small in comparison to that of the Upper Devonian that its area of outcrop is very small. It occurs in the syncline (Meadow Branch) to the east of Wardensville, in the syncline to the southwest of Moorefield [Middle Mountain ("Trough") Syncline], in the Clearville Syncline to the north of Moorefield, and on either side of the great Upper Devonian belt but nowhere between.

Contacts.—The lower contact of the Genesee has already been discussed under the Hamilton. There is here a decided unconformity.

The upper contact of the Genesee with the Portage is seemingly transitional. The line has been drawn where the thinner-bedded sandstones of the upper shale and sandstone portion give place to the thicker-bedded sandstones. There are also fewer fossils in these thicker-bedded sandstones and shales. It is very probable that the line between the Genesee and the Portage in Hardy County has not always been drawn at the same horizon.

Fossils.—The most common fossils in the Genesee are thin-shelled pelecypods, cephalopods, and pteropods. The most abundant species are: Pterochaenia fragilis, Buchiola retrostriata, Styliolina fissurella, Bactrites aciculum. These species with a few others range through the black shales as well as the upper more arenaceous portion. Besides the fossils listed above as common, the following were seen in the two collections made from the Genesee in Hardy County: Buchiola mariae, Buchiola sp., Probeloceras lutheri, cf. Pharetrella tenebrosa, cf. Liopteria sp., and small fragments of plant remains.

Collections were made at fossil localities 14, 30, and 38B (bottom) as follows:

Collection 14.

About 2 miles south of Petersburg, just below big bend in public road.

Mollusca

Pelecypoda

Buchiola mariae Clarke
Buchiola retrostriata (von Buch)
Buchiola sp.
Liopteria sp.
Pterochaenia fragilis (Hall)

Pteropoda
Styliolina fissurella (Hall)
Cephalopoda
Bactrites aciculum Hall
Probeloceras lutheri Clarke.

Collection 30.

1/2 mile southeast of Oakdale, about 4 miles southwest of Moorefield.

Mollusca
Pelecypoda
Buchiola retrostriata (von Buch)
Pteropoda
Styliolina fissurella (Hall)
Cephalopoda
Bactrites aciculum Hall
Bactrites sp.

Collection 38B.

Bottom. By branch, north of highway, about 1/2 mile northeast of Moorefield.

Molluscoidea
Brachiopoda
Orbiculoidea sp.
Mollusca
Pelecypoda
Actinopteria sp.
Buchiola retrostriata (von Buch).

Subdivisions.—There are two divisions of the Genesee, a lower and black, argillaceous and carbonaceous shale, and an upper more arenaceous shale and thin-bedded sandstone portion. Both of these portions are quite variable in thickness and character.

The following is a section measured about 2 miles south of Petersburg, Grant County:

Section Genesee Shale, 2 Miles South of Petersburg, Grant County.

Portage		
Genesee (471′)		Feet
Rusty- to gray-weathering, platy and hackly, arenaceous and argillaceous shale, some Styliolina fissurella and pelecypods	22	
Slightly dark-weathering, arenaceous shale, with occasional 2″ sandstone layer	60	
More sandy and dark-gray to green arenaceous shale, somewhat wavy, with many fossils, Styliolina fissurella and smooth pelecypod	77	
Green-gray arenaceous shale, rather platy	50	
Arenaceous shale, slightly lighter in color	23	
Black arenaceous shale	79	
Black argillaceous shale	160	471
Hamilton Sandy Shale		

The top 50 feet of rocks in the section carries Pterochaenia fragilis (Hall), Styliolina fissurella (Hall), and cf. Liopteria sp.
Shaly sandstone with surface markings of long lines and pits similar to ones seen on beach where wash from waves occurs.
The middle and lower portion of the Genesee carries: Pterochaenia fragilis (Hall), Buchiola retrostriata (von Buch), Buchiola mariae Clarke, Probeloceras lutheri Clarke. Styliolina fissurella (Hall), Bactrites aciculum (Hall), cf. Pharetrella tenebrosa Hall, Buchiola sp., irregular-shaped concretions, many thin and elongated carbonaceous markings (plant remains).

Economic Aspects.—Like the Marcellus, the lower portion of the Genesee is very highly argillaceous and could be used either for brick making or as a mix with limestone in the manufacture of Portland cement. There has been locally and chiefly in the distant past much prospecting in the black argillaceous shales of the Genesee for coal. So far as known these shales never have associated coal seams.

PORTAGE.

General Account.—The Portage Series of rocks in Hardy County is composed of a succession of shales and sandstones. Both shales and sandstones are greenish-gray in color. The shales are slightly thicker than the sandstones and are usually arenaceous. The sandstones are rather compact and hard-grained, and flaggy, varying from 2 to 6 inches in thickness and frequently have wavy surfaces and streaks such as are made by waters under close to shore conditions. The entire series of shales and sandstones is practically without marine fossils in its exposure in Hardy County.

Thickness.—As measured in different places the Portage of Hardy County varies from 1200 to 1700 feet. In many sections there is so much minor folding that measurements of thickness are very unreliable. The best places to get such measurements are where the rocks have a steep dip. At such localities there is apt to be a thinning of the shales due to lateral pressure.

Topography.—The Portage is less resistant to weathering than the Chemung and the Catskill above it and more resistant to weathering than the Genesee, Hamilton, or the Marcellus below it. On this account it is usually found to outcrop on the slopes of the synclinal mountains in which the higher rocks are composed of the heavier sandstones of Catskill, Chemung, or Pocono age. In two areas, the Middle Mountain ("Trough") Syncline and the Clearville Syncline,

PLATE LXXII.—A typical exposure of Portage Shale and Sandstone at Mathias in the southeastern part of the county. The exposure shows about 35 per cent. sandstone and 65 per cent. shale. The sandstone layers are from about 2 inches to about 10 inches in thickness. The Portage is practically without fossils.

the Portage forms the crest of the elevation but in all other outcrops it occupies the slopes.

Areal Extent.—In every exposure in the county the Portage is associated with a synclinal structure. In the northwestern part of the county the Portage outcrops in the center of the Clearville Syncline in a strip about 0.75 mile wide by about 3 miles long. In the southwestern part of the county in the Middle Mountain ("Trough") Syncline the outcrop is along the axis of the syncline and has a width of about one mile an da length of about 5.5 miles. There is a continuous outcrop of the Portage rocks from Hampshire County on the north to Pendleton County on the south, a distance of 31 miles, along the eastern side of the main Moorefield valley to the north and the valley of the Moorefield River to the south. This outcrop is everywhere on the slope of the relatively prominent highland to the east of these valleys.

Another important outcrop is along the eastern limb of the Sideling Hill Syncline and just to the west of the Lost River Valley. This outcrop is entirely across the county about 27 miles, and toward the south it broadens out into a synclinal basin with low dip, the West Mountain Syncline.

In the northeastern part of the county there is a loop of Portage rocks that surrounds a Chemung highland which extends into Hardy County from Hampshire County a distance of about 5.5 miles.

Contacts.—The lower contact of the Portage has already been discussed under the description of the Genesee.

The upper contact of the Portage with the Chemung, like the lower contact, is difficult to draw with any great precision. Theoretically the division is made where the marine fossils, more especially the crinoid stems, occur in some profusion, the Portage being barren of fossils or practically so. Other marine forms occur in the basal Chemung but the crinoid stems are the most common. Besides the fossil evidence, the lithological conditions are found to be of much help in drawing the line. The sandstone beds in the Chemung are thicker and form a larger percentage of the rock mass than they do in the Portage. They also have a more olive-green color. The above lines of evidence taken together with the topographic condition of the higher ground of the Chemung than Portage make it possible to draw the line with some degree of accuracy without detailed study.

Fossils.—The Portage Series of rocks are practically without fossils in Hardy County as they are in the two counties to the west.

Subdivisions.—In the Maryland area to the north and in Mineral and Grant Counties on the West Virginia side of the river, subdivision of the Portage can be made on a faunal basis but due to the scarcity of fossils in the Portage of Hardy County and to the more or less uniform character of the lithology throughout, subdivision of the Portage has not been attempted.

Economic Aspects.—There is nothing about the Portage which can be utilized commercially to any great advantage. The thinner flags could be used for sidewalk and curbing stone if the deposits were near a large city. The shales are all too sandy for brick or for cement but make fairly good road-surfacing material. The soils from the Portage are too sandy and low in plant foods to be of much value.

CHEMUNG.

General Account.—The Chemung is composed of interbedded greenish to gray and usually white-weathering sandstones of from 5 to 10 inches or more in thickness and olive, arenaceous shales. Some of the sandstones weather to a rotten, yellow or brown, porous condition which shows that they were both calcareous and ferruginous. It is in such layers that most of the fossils occur. Some of the sandstone beds are massive and reach a thickness of several feet. This is especially the case toward the top of the series, but thick beds near the base as well as elsewhere in the series are not uncommon. Many of these sandstones and arenaceous shales give evidence of their having been deposited in shallow-water conditions. Flattened white quartz pebbles occur in some of the thicker and coarser sandstone and conglomerate beds. There is usually a conglomerate not far from the base of the Chemung and the top of the series is drawn at the top of the Hendricks Sandstone, which is usually a conglomerate. Toward the northeastern part of the county and locally elsewhere "red beds" similar to those in the Catskill occur below the Hendricks Sandstone.

Thickness.—The thickness of the Chemung does not vary much from 2000 to 2500 feet. At the exposure near Baker in the Lost River Valley its thickness is about 2200 feet. East of Moorefield the thickness has been estimated from 2000 to 2500 feet.

Topography.—In most of its outcrops the Chemung is located on comparatively high ground. The heavy sandstone at the top of the Chemung is usually a ridge former and the sandstones at or near the base which are thicker than the sandstone beds in the Portage cause the outcrop of these beds to stand above the outcrop level of the Portage so that the line of division between the Portage and the Chemung is roughly outlined by a break in the topography.

Areal Extent.—With the exception of the two small outcrops, one in the syncline (Meadow Branch) to the east of Wardensville and the other in the West Mountain Syncline in the southeastern part of the county, the exposures of the Chemung rocks are confined to the area between the Lost River Valley and the Moorefield River Valley. In this latter area there are two long strips which reach from the Hampshire County line on the northeast to the Pendleton and Rockingham (Virginia) County line on the southwest. These two belts border the great central synclinorium with its three synclines and two anticlines. The eastern of these two anticlines brings up the Chemung in a belt about one mile wide which extends from the Hampshire County line to within 6 miles of the Rockingham (Virginia) County line. The western of these two anticlines is less extensive than the eastern and along its axis the Chemung is exposed in a small area extending southward from the Hampshire County line for about 3.5 miles. The remaining rocks exposed in the area of the great synclinorium are younger than the Chemung.

Contacts.—The condition of the contact with the Portage has already been discussed, page 326.

The upper boundary of the Chemung is drawn at the top of the heavy sandstone and conglomerate bed which comes in just below the deeply colored "red beds". This top or Hendricks Sandstone is greenish-gray to brown where unweathered but the weathered surfaces are white. The Hendricks Sandstone carries an abundant fauna, Spirifer disjunctus being one of the more common species. The overlying red beds are practically without fossils for a considerable distance above the Hendricks Sandstone, although there is a return of the Spirifer disjunctus fauna at a horizon some 1000 to 1500 feet above the Hendricks Sandstone in the Catskill. In some of the sections toward the northeastern part of the county red beds occur below the Hendricks Sandstone.

It is now a well-known fact that the non-marine sediments of the Catskill toward the east are contemporaneous with at least a portion of the marine sediments of the Chemung to the west. These marine and non-marine sediments dovetail due to the shifting of the strand line. The contact between the marine and the non-marine deposits represents a younger geological time in the east than it does in the west. If we call the non-marine deposits Catskill and the marine deposits Chemung, the line of demarcation represents different geological times in the different areas. It is a common practice to call the purely marine portion Chemung, the purely non-marine the Catskill, and the zone in which there is a dovetailing of the marine and the non-marine the transitional. In the Hardy County area this transitional zone is placed in the Catskill and the line drawn at the top of the beds in which the marine conditions are predominant.

Fossils.—One small collection (No. 39) was made from the Chemung in Hardy County but fossils were noted in a number of sections. The sandstones are more fossiliferous than the shales and the calcareous and ferruginous beds carry more than the highly siliceous layers. The following forms are common: Spirifer disjunctus, Atrypa reticularis, Camarotoechia contracta, crinoid stems, and casts of Loxonema sp.

Collection No. 39 shows the following, while the second list gives those found at various localities as identified in the field:

Collection 39.

On Moorefield-Wardensville road, 0.6 mile southwest from Sugarloaf Knob.

Molluscoidea
- **Brachiopoda**
  - Camarotoechia congregata var. parkheadensis Swartz

Mollusca
- **Gastropoda**
  - Loxonema sp.

Field Identifications, Various Localities.

Plants
- Plant fragments

Molluscoidea
- **Brachiopoda**
  - Camarotoechia contracta (Hall)
  - Camarotoechia eximia (Hall)
  - Spirifer disjunctus Sowerby
  - Schuchertella cf. chemungensis (Conrad)

Mollusca
- **Gastropoda**
  - Cyclonema multistriata Clarke
- **Pteropoda**
  - Tentaculites sp.

Subdivisions.—The Chemung of Hardy County has not been studied in sufficient detail to warrant its subdivision either lithologically or faunally.

Economic Aspects.—The shales are too sandy for use for brick or cement manufacture and the sandstones are too expensive to quarry and shape into building blocks to compete with other building materials. Soils from the Chemung are light and require much fertilization. The blocky-weathering sandstones which weather from the shale and sandstone outcrops are very objectionable from an agricultural standpoint. The soils are more suited for timber and orchards than for agriculture.

CATSKILL FORMATION.

The rocks of the Catskill are interbedded shales and sandstones of a deep-red color for the most part but have gray- to olive-brown-weathering sandstones and some greenish, buff-weathering shales in the upper and lower portions of the formation.

The sandstones are variable in thickness, lensic in character, often with clay pellets and usually micaceous. A large percentage of the sandstones are argillaceous and break into thin layers in weathering.

The shales are arenaceous, often ripple-marked and sun-cracked. Toward the base of the formation the shales are more important than the sandstones and locally gray to buff layers alternate with the red layers.

The section given below of the rocks exposed along the highway down the mountain southwest from Helmick Rock is typical of the Catskill, as is also the less detailed section along the Moorefield-Wardensville road near Needmore.

Thickness.—The most accurate measurement of the Catskill is the one near Helmick Rock. Here the Catskill has a thickness of over 4700 feet. The section near Needmore does not include some of the upper beds seen in the Helmick Rock section but the thickness is here 3900 feet.

Section Down West Slope South Branch Mountain From Helmick Rock.

	Feet.
Pocono	
Very heavy sandstone of Helmick Rock cliff	
Catskill (4755')	
Upper gray sandstone portion:	
Concealed	200
Grayish to olive, brown-weathering, fine- to coarse-textured sandstone, and dark, brownish-red, arenaceous shale in beds from a few inches to 30 feet, about as much sandstone as shale	1050
Olive to gray, brown-weathering and rather thin-bedded sandstone	150
Lower red sandstone portion:	
Alternating beds of red sandstone and buff arenaceous shale in beds of about 10 to 15 feet each, much concealed	335
Red sandstone and red arenaceous shale, in beds 5 to 30 feet, much concealed	520
Mostly alternating shales and heavier-bedded (25+') sandstones, most of the shale dark-red and chunky-weathering, but some buff-colored. Most of the sandstones are red but some are green- and brown-weathering	750

Red sandstones and thicker, interbedded shales. Less steep slopes here showing a higher percentage of shale, much concealed	Feet. 570	
Largely arenaceous shales of red and buff character, with an occasional red sandstone	600	
Largely arenaceous shale with thinner bands of sandstone. Shales are as much gray and buff as red	160	
Red, arenaceous shales with a few buff, arenaceous shale layers	420	4755

Chemung

Gray sandstones and shales, largely concealed

Section Southeast Slope South Branch Mountain Northwest of Needmore.

Catskill (3900′)	Feet.	
Portion with heavier sandstone beds, not including the top portion of the Catskill	2100	
Less sandy portion of the Catskill. This part makes more gentle slopes and is less exposed, more shale	1800	3900

Hendricks Sandstone of the Chemung

Topography.—The Catskill outcrops are all on relatively high ground. This is due to the fact that they occupy synclines and also to the fact that the formation itself as well as the Chemung and the Portage below it have many resistant sandstone beds. The Hendricks Sandstone immediately below it is a prominent ridge former. The Pocono Sandstone which covers the Catskill in a few places holds up the center of the syncline to elevations as great or greater than does the Medina Sandstone in the eastern part of the county. The structures in which the Catskill occurs are large and as a result the rocks are nearly flat and the resultant stream erosion in these flat-lying rocks is dendritic in pattern with ridges running in many directions. Only along the trough of the synclines is there a decided northeast-southwest direction to the ridges. In the southern portion of the county where the synclines die out and the rocks from both the structures join in a common highland with flat rocks, the irregular trend of the ridges is especially marked.

Areal Extent.—The entire outcrop of the Catskill is confined to the great central geosynclinal with its three synclinal basins. The two larger ones parallel each other with a narrow Chemung outcrop between for most of the distance from the Hampshire County line to the Pendleton and Rockingham (Virginia) County lines. Six miles north of the Rockingham County line the Chemung tongue dies out as the anticline plunges to the southwest and the two Catskill outcrops merge in the flat-rock country of the Shenandoah Mountain area.

The western syncline is short and extends but about ten miles south from the Hampshire County line. This syncline unites laterally with the syncline to the east of it by the pinching out of the two small anticlines which separate them. This union occurs where South Branch Mountain makes its sharp turn from the northeast course to run for a few miles in a general northwest course.

The Catskill has a greater area of outcrop than any other formation in Hardy County. It occupies the most inaccessible portion of the county and much of it is still rather heavily timbered.

Contacts.—The lower contact with the Chemung has been discussed on page 328.

The upper contact is drawn where the red shales and interbedded greenish-gray sandstones give place to the coarser sandstone and gray-colored shales of the Pocono.

Fossils.—The Catskill is practically without fossils with the exception of a few plant remains scattered through the rocks at different horizons and the recurrent Spirifer disjunctus fauna which has been seen in Hampshire County to the northeast of Hardy at a horizon a few hundred feet above the base of the formation and which is doubtless to be found in the rocks of Hardy County at the same horizon.

Subdivisions.—As can be seen from a study of the section representing conditions near Helmick Rock, pages 330-1, there is an upper portion in which the sandstones are gray to olive and brown-weathering associated with red shales. There is also a lower portion in which the sandstones are practically all red. The upper portion of this division has shales which are also largely red but the lower portion of this division not only has a much higher percentage of shale than the overlying Catskill but many of the shale beds are gray and buff. While this generalization holds for the different sections, there is great irregularity in the minor characteristics of the deposit.

Economic Aspects.—The red sandstones are too high in clay content to be used for building purposes. Most of the shales are too arenaceous to be of use for brick making. The soil from the Catskill is usually a deep-red loam which is suitable for agriculture and also good for orchards.

The cut for the new county road 1.1 miles east of Needmore opposite the Baker Run Church exposed some black, pyritous shale which the residents called "coal", occurring in the Catskill Series. To satisfy the people of the vicinity that it was not coal, a sample was collected by Tucker for analysis by B. B. Kaplan, Chemist of the Survey, who reported the results as follows (Sample No. 10-T, Laboratory No. 2940):

	Per cent.
Silica (SiO_2)	71.00
Ferric Iron (Fe_2O_3)	10.25
Alumina (Al_2O_3)	8.10
Loss on Ignition	10.20
Total	99.55

The analysis discloses no "coal", but there may have been some combustible material present since the "loss on ignition" is rather high.

MISSISSIPPIAN SYSTEM.

The Mississippian System of rocks is represented in Hardy County by a few hundred feet of thickness of sandstones and shales. These occur in but two areas, the center of the Whip Cove and Sideling Hill Synclines and their outcrop is confined to a strip from 0.25 mile in width to 1 mile in width, extending north from Helmick Rock for about 8 miles in the most inaccessible portion of the county, and for 7 miles northward on Short Mountain with a width of 0.25 to 1 mile.

Toward the base of these rocks occurs a rather heavy sandstone formation which makes the prominent cliff at Helmick Rock. From the topography it appears that this is followed by a shale which makes a bench on the mountain and that this is in turn overlain by a more resistant sandstone formation which is the youngest rock found in Hardy County. The author did not study these rocks and can not therefore give a detailed account of their character and thickness. Messrs. R. C. Tucker and Paul H. Price, who examined this portion of the syncline, give the following account:

POCONO SERIES.

Of the five divisions of the Pocono Series reported in adjacent parts of the State, only the lowest two are to be found in Hardy County:

Purslane Sandstone.
Rockwell Formation.

In Hampshire County the Hedges Shale, overlying the Purslane Sandstone, was found in one small area, as noted by Dr. Tilton on page 100 of this report.

The Myers Shale and Pinkerton Sandstone coming above the Hedges Shale are also absent from Hardy County.

The basal buff shales and soft sandstones are grouped under the name **Rockwell** from the exposures on Rockwell

Run, whose valley separates Purslane Mountain from Sideling Hill, in Morgan County.

There are two areas in Hardy County in which rocks of Pocono age exist at this time. One area is on South Branch Mountain, extending from Helmick Rock to a point about one mile south of Fabius, a distance of approximately 9 miles. The width of crop varies from 0.3 to 1.3 miles.

The Purslane is doubtfully identified in the Sand Spring region and at the northern point of this exposure. A photograph (Plate LXXIII) shows a view of Helmick Rock. The cliff here is about 235 feet hig from the wind gap where road crosses the mountain. Considerable debris of grayish-white sandstone covers the slope to the flat below. The top of the ledge is rather thin-bedded, platy, and yellowish-brown. The strike is S. 37° E., and dip varies from 8° to 10° northeast. The outcrop occurs about the axis of the Whip Cove Syncline.

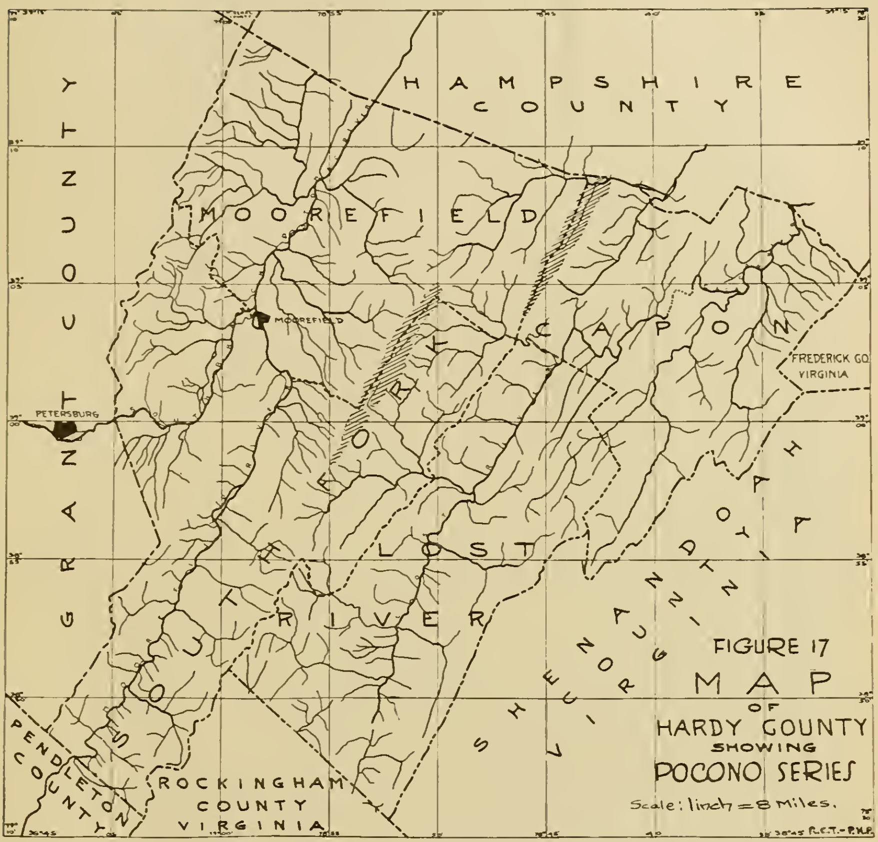
Tucker collected a sample (No. 11-T, Laboratory No. 2948) of the sandstone from the ledge at Sand Spring for analysis by B. B. Kaplan, Chemist of the Survey, who reports as follows. The ledge here is heavy-bedded, grayish-white:

	Per cent.
Silica (SiO_2)	97.10
Ferric Iron (Fe_2O_3)	0.85
Alumina (Al_2O_3)	0.85
Lime (CaO)	0.30
Loss on Ignition	0.80
Total	99.90

The analysis of a sample (No. 13-T, Laboratory No. 2945) collected by Tucker from the ledge at Helmick Rock shows the following on analysis by B. B. Kaplan, Chemist of the Survey:

	Per cent.
Silica (SiO_2)	96.10
Ferric Iron (Fe_2O_3)	1.02
Alumina (Al_2O_3)	2.68
Lime (CaO)	0.20
Loss on Ignition	0.45
Total	100.45

The following outline map of Hardy County, prepared by Paul H. Price, shows the areal extent of the Pocono Series of the Mississippian in the area:


HAMPSHIRE COUNTY
GRANT COUNTY
MOOREFIELD
MOOREFIELD
PETERSBURG
CAPON
FREDERICK CO. VIRGINIA
SOUTH FORK
LOST
RIVER
SHENANDOAH MOUNTAIN
PENDLETON COUNTY
ROCKINGHAM COUNTY VIRGINIA
FIGURE 17
MAP OF HARDY COUNTY SHOWING POCONO SERIES
Scale: 1 inch = 8 Miles.
R.C.T.-P.H.P.

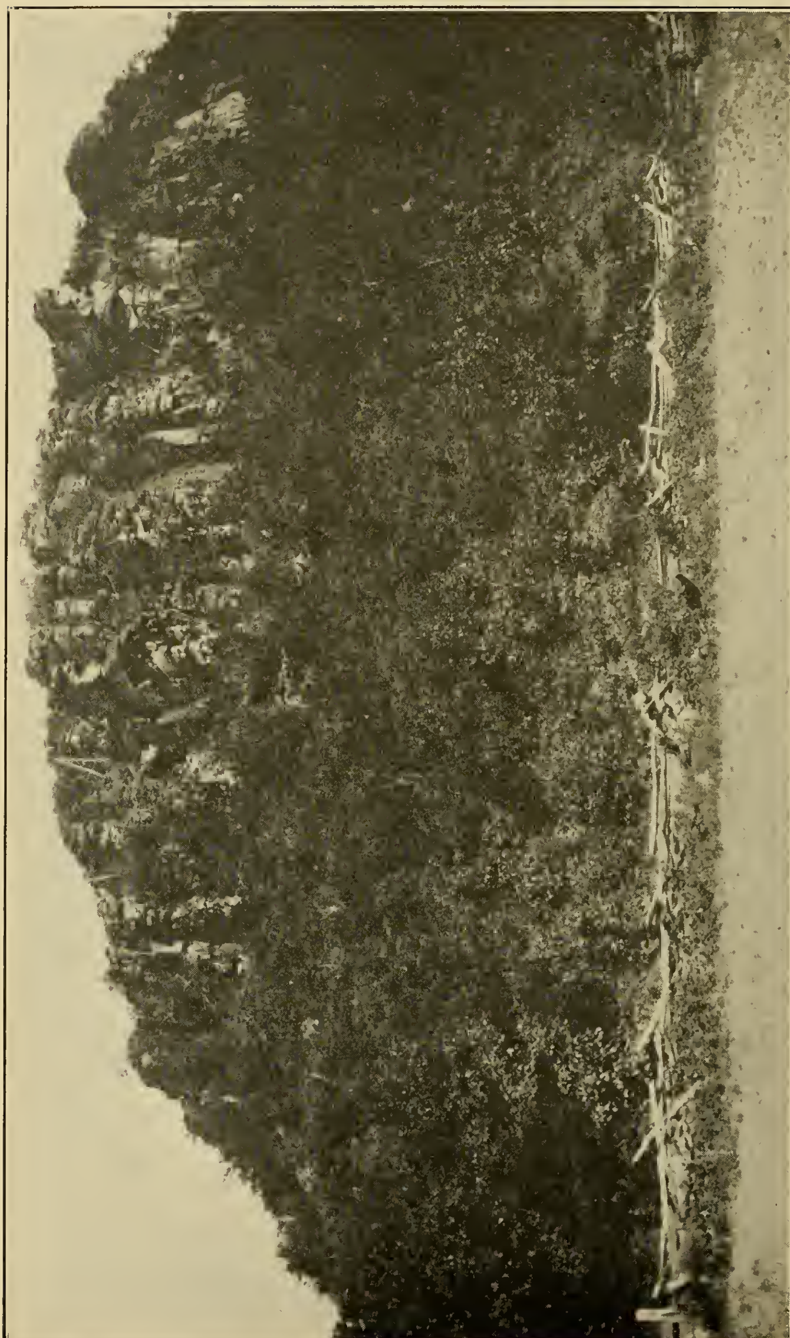


PLATE LXXIII.—View of Helmick Rock, looking north. The cliff is about 235 feet high at this point with slope to wind gap at road covered with debris from the Pocono.

The second area of Pocono Rocks in Hardy County is a continuation of the exposure in Hampshire County, extending from the county line a distance of approximately 7 miles to a point one mile north of Needmore. This area varies from 1/4 to 1 mile in width, with an average of about 0.7 mile and is on Short Mountain and the axis of the Sideling Hill Syncline nearly bisects the exposure. The total thickness of Pocono Rocks exposed in Hardy County is approximately 500 feet, possibly a little less.

No coals were observed in any of the shales of the Pocono which in Morgan County hold some impure semianthracitic seams.

MEASURED SECTIONS.

Section From 1 to 2.5 Miles Southeast of Lost City, Through Shenandoah Mountain.

		Feet.
Bloomsburg Red Sandstone		40
Niagara (McKenzie), concealed		230
Keefer Sandstone		20
Clinton, mostly concealed		560
White Medina (Tuscarora)		400
Red Medina (Juniata)		550
Gray Medina		
Coarse-grained sandstone, many layers with yellow to brown spots in the sandstone	150′	
Concealed, probably gray sandstone	200	
Gray Medina, fine-grained, dark-gray sandstone	50	400
Martinsburg		
Concealed, but almost certainly Martinsburg Shales and Sandstones	550′	
Dark-gray arenaceous shale and thin beds of dark-gray sandstone, overturned and sheared. This layer is shown in Plate L, page 223	40	
Concealed, probably largely shale	350	
Dark-gray arenaceous shale and thin, gray sandstone, overturned and sheared, graptolites	65	1005
Concealed		

Section Clinton, Along Wardensville-Moorefield Road for About 1/4 Mile East From McCauley.

	Feet.
Niagara (McKenzie)	
Clinton	
Concealed	35
Massive, white to gray, quartzitic sandstone glistening in sun, from the surface of small quartz crystals in many quartz druses (Keefer Sandstone)	30
Concealed, probably in part shale	4
Thin-bedded, quartzitic sandstone (lower bench of Keefer)	7

	Feet.
Thin-bedded, olive to gray, arenaceous and argillaceous shale	20
Olive to gray to buff, arenaceous and argillaceous shale with 1"to 3" green to gray sandstone layers which are more calcareous and ferruginous toward the top and carry Tentaculites minutus and a few other fossils	40
Deep-red, ferruginous sandstone (Iron Sandstone)	12
Olive to gray, arenaceous shale with few argillaceous calcareous sandstones in 1" to 3" bands	190
Like above, but more sandstone than shale and sandstones, 1" or more thick	15
Olive to gray sandstone and shale, less sandstone than shale	12
Mostly hard, olive to gray sandstone	10
Olive to gray sandstone and shale, about equal parts	10
Like above, but more shale than sandstone	15
More shale than sandstone	15
Mostly olive to gray sandstone in beds of more than 1"	5
Olive to gray shale	10
Concealed, probably mostly shale	56
Buff, quartzitic sandstone	1
Dark-gray to green, arenaceous shale and thin, wavy sandstone	10
Gray argillaceous sandstone	3
Gray arenaceous shale	1
Massive white sandstone of the White Medina (Tuscarora)	

Section of the Niagara (McKenzie) Just East of McCauley, Moorefield-Wardensville Road.

		Feet.
Buff-weathering arenaceous and argillaceous shale and thin-bedded argillaceous and calcareous sandstone in 1" to 3" layers. 130 feet below top fossils	106'	
At bottom fossils	107	213
Thin-bedded, hard, buff-weathering sandstone and arenaceous buff shale, mostly sandstone		4
Dark argillaceous and arenaceous shale, weathers buff to gray		15
Concealed, probably shale and with lower limit of formation in this horizon		35
Keefer Sandstone		

Section From the Top of Bossardville to the Bottom of the Red Medina, Wardensville-Moorefield Road 1/4 Mile East of McCauley.

	Feet.
Bossardville	
Bloomsburg Red Sandstone	36
McKenzie Shale, Limestone, and Sandstone	300
Keefer Sandstone	30
Clinton Shale and Sandstone	400
White Medina (Tuscarora)	256
Red Medina (Juniata)	150
Concealed	

Small Exposure, Contact Bossardville and Helderberg, 0.6 Mile West of Brake.

	Feet.
Helderberg	
Massive, compact, crystalline limestone, exposed	15
Cobbly limestone	5
Bossardville	
Thin-bedded calcareous sandstone or sandy limestone	7
Pure, thin-bedded, fine-grained limestone	8

Section Along Wardensville-Moorefield Road, Beginning at Bottom of Oriskany, 2.5 Miles Northwest of McCauley, and Going Westward 0.4 Mile to Bottom of Bloomsburg Sandstone.

	Feet.	
Oriskany Sandstone		
Helderberg (200′) (May be partly faulted out)		
Concealed—no chert fragments seen, probably New Scotland and Coeymans (if present) and also in part Keyser	127′	
Coarse-grained gray limestone, very fossiliferous, with Favosites and criniod stems abundant. Probably Keyser in age	5	
Concealed	48	
Massive-bedded, dark-gray, spotted, fine-grained, reticulated and fossiliferous limestone, many brachiopods, Favosites, crinoid stems, etc.	20	200
Bossardville (333.5′)		
Thin-bedded, calcareous shale and thin beds of impure limestone, gray-weathering and ribbony	80	
Massive, dark-gray, fine-grained, pure, conchoidal fracturing, banded and light-weathering limestone, strike N. 30° E.; dip, 65° E.	1.5	
Thin-bedded, shaly limestone, weathering in thin sheets	90	
Hard, compact, brittle, dark-gray, pure, thin-bedded limestone, with conchoidal fracture	5	
Thin-bedded, shaly limestone	15	
Rather pure, dark-gray limestone, small Stromatopora, etc.	2	
Shaly limestone	10	
Shaly, calcareous and ferruginous sandstone and sandy ferruginous shale, mostly sandstone	12	
Rather pure and more massive, gray limestone, Hindella congregata, Stromatopora, and other fossils common	18	
Massive gray limestone with many Stromatopora, Favosites, bryozoa, and Hindella congregata	5	
Shaly, thin-bedded limestone	10	
Massive, argillaceous, gray limestone, with some thin bands	25	
Massive, gray limestone	28	
Thin-bedded, impure limestone, with few thin, black chert layers	2	

	Feet.	
Concealed	8	
Thin-bedded, fossiliferous, impure limestone with Favosites, Camarotoechia sp., Hindella congregata, bryozoa, etc.	8	
Largely concealed, but many yellow sandstone fragments in soil (largely a sandstone layer)	10	
Calcareous an dargillaceous sandstone, with Stromatopora	4	333.5
Rondout (458′)		
Concealed, probably mostly shale	83	
Buff to gray-weathering, calcareous shale and argillaceous, thin limestone	220	
Calcareous sandstone (0′ 8″)	0.7	
Dark-gray, thin-bedded shale (1′ 4″)	1.3	
Arenaceous and calcareous shale	14	
Argillaceous and calcareous sandstone	3	
Thin-bedded, dark, arenaceous shale	6	
Buff-weathering, calcareous, and argillaceous sandstone	3	
Thin-bedded, dark--gray, arenaceous shale	10	
Coarse, gray sandstone (spring here)	3	
Coarse, buff-weathering sandstone	6	
Thin-bedded, dark-colored shale	4	
Buff-weathering, shaly sandstone	4	
Thin, buff-weathering shale	3	
Sandstone	1	
Gray shale	10	
Shaly sandstone	3	
Dark-gray shale and limestone	10	
Dark-gray, compact, ribbony, conchoidal-fracturing limestone	3	
Shale	9	
Dark-gray, compact, ribbony limestone, like 9′ layer	1	
Thin-bedded, dark-gray, calcareous and arenaceous shale	25	
Heavy bed of gray sandstone	1	
Very dark-gray, very thin-bedded, calcareous shale, with openings which look like worm-borings, probably bryozoa or clay-balls	4	
Sandstone, with many clay-balls	1	
Black arenaceous shale	4	
Gray, thin-bedded, arenaceous shale, many sun-cracks	25	458
Bloomsburg (33′)		
Thick-bedded, brownish-red to buff sandstone	33	33
Niagara (McKenzie) --		
Buff-weathering shale		

Section Through Oriskany and Helderberg Beginning Along Road 1.1 Miles Northwest From Thrasher Spring School.

Marcellus Black Shale	
Oriskany (339′)	
Non-cherty member (Ridgeley) (203′) carrying:	
Spirifer arenosus (Conrad)	
cf. Oriskania lucerna Schuchert	

	Feet.	
Stropheodonta sp.		
Spirifer cf. murchisoni Castelnau		
Meristella sp.		
Cup coral		
Rather coarse-grained and easily weathered, calcareous and fossiliferous sandstone	90′	
More siliceous and less fossiliferous, coarse-grained sandstone	20	
Coarse-grained, calcareous sandstone	93	203
Cherty Member (Shriver) (136′)		
Black chert in calcareous sandstone with some crystalline dark limestone	62′	
Same as above but having 50 per cent. or more of chert	74	136
Helderberg (374.5′)		
New Scotland (20′) with many fossils:		
Hindia sphaeroidalis Duncan		
Leptaena rhomboidalis (Wilckens)		
Spirifer macropleurus (Conrad)		
Eatonia singularis (Vanuxem)		
Eatonia medialis (Vanuxem)		
Platyceras sp.		
Massive white chert	5′	
Thin-bedded, white-weathering, cavernous chert, and with many fossils	15	20
Coeymans (9′ 5″) dark, crinoidal limestone carrying:		
Atrypa reticularis (Linne)		
Gypidula coeymanensis Schuchert		
cf. Rhipidomella oblata (Hall)		
Spirifer cf. octocostatus Hall		
Spirifer cf. cyclopterus Hall		9.5′
Keyser (345′)		
Fine-grained, dark limestone, few fossils	7′	
Fine-grained, blue, laminated limestone, resembling beds in the Bossardville	17	
Massive, dark, fine-grained limestone (Tentaculites zone) Fossils:		
Tentaculites gyracanthus (Eaton)		
cf. Meristella praenuntia Schuchert	5	
Dark, irregular-bedded, very fossiliferous limestone; Brachiopods, bryozoa, and near base, Stromatopora	38	
Thin-bedded, argillaceous, light-gray limestone, with shale partings	20	
More massive, dark-colored limestone, rather fossiliferous, fossils poorly preserved	60	
Shaly and cobbly limestone, with an occasional chert layer	28	
Concealed	20	
Heavier-bedded limestone, weathering into irregular pieces (cobbly)	150	345

Bossardville (incomplete) (389′+)	Feet.	
Much concealed, but largely compact, gray limestone, weathering into thin bands	289′	
More massive, dark grayish-blue limestone, near top Stromatopora-Favosites zone (picture, Plate LX) Ten feet below top: Favosites niagarensis Hall Hindella congregata Swartz (C. K.) Streptelasma sp. Stromatopora sp. cf. Aulopora sp. (In the Maryland section this zone is about one-third the distance up from the bottom of the Tonoloway). Twenty feet below top: Hindella congregata Swartz (C. K.) Leperditia alta (Conrad) Stropheodonta sp. One hundred feet below top: Camarotoechia litchfieldensis (Schuchert)	100	389

Section of Oriskany and Most of the Helderberg, West Slope of Elkhorn Mountain, 2 Miles East of Durgon.

	Feet.
Black Shale of the Marcellus	
Oriskany Sandstone (274′)	
Ridgeley non-cherty member (141′)	
Rather coarse-grained, formerly calcareous sandstone with many fossils: Spirifer arenosus, Rensselaeria ovoides, Tentaculites sp. (glass-sand layer)	30′
Very heavy bed of light-gray, siliceous sandstone, stands up in high wall (Plate LXIV), very few fossils	22
Less massive, siliceous, gray sandstone	17
Ferruginous sandstone, many fossils, Spirifer arenosus, etc.	5
Thin-bedded, gray to brown sandstone, few fossils	38
Dark-gray to brown, thin-bedded and shaly sandstone, fossils common	15
Like the above but containing a few chert concretions	5
More massive sandstone and more chert	6
Somewhat cherty and very fossiliferous sandstone, with: Leptaena rhomboidalis var. ventricosa (Hall) Schuchertella woolworthana (Hall) Schuchertella cf. becraftensis (Clarke) cf. Chonetes hudsonicus Clarke Spirifer tribuarius var. pauciplicatus n. var. Spirifer cf. cumberlandiae Hall Spirifer angularis Schuchert Spirifer intermedius Hall Spirifer paucicostatus Schuchert Spirifer angularis var. tribulis v. nov. Rensselaeria (Beachia) suessana var. immatura Schuchert	

	Feet.	
Anoplotheca flabellites (Conrad)		
Meristella lentiformis Clarke		
Tentaculites elongatus Hall	3	141
Shriver Chert Member (133′)		
Very fine-grained, calcareous sandstone and dark-gray, impure limestone with concretionary, black chert throughout and increasing toward the bottom (In bottom 35 feet chert is more than 50 per cent. of the rock) Bottom foot carries some poorly preserved Ostracods	120′	
Shaly sandstone with little or no chert	5	
Shaly and calcareous sandstone, few fossils, collection from top foot:		
Anoplotheca dichotoma Hall		
Leptaena rhomboidalis (Wilckens)	8	133
Helderberg (312′+)		
New Scotland (29′)		
Shaly and calcareous sandstone, collection from bottom foot:		
Orbiculoidea aff. discinisca (Hall)		
Leptaena rhomboidalis (Wilckens)		
cf. Dalmanella perelegans (Hall)		
Spirifer cyclopterus Hall		
Spirifer concinnus Hall		
Spirifer perlamellosus Hall		
cf. Eatonia medialis (Vanuxem)		
Eatonia lirata n. sp.		
Meristella cf. arcuata (Hall)	2′	
Cherty, medium-grained, dark-gray limestone with much white-weathering chert in thin to irregular beds, top few feet with little shale, but containing Spirifer macropleurus	27	29
Coeymans (26.5′)		
Crystalline gray crinoidal limestone, many Gypidula coeymanensis	26.5′	26.5
Keyser Member (256.5′)		
Gray calcareous shale	4′	
More compact, darker gray limestone, with many crinoid stems and bryozoa	10	
Nodular, gray limestone, collection:		
Strophonella keyserensis Swartz (C. K.)		
Stenochisma formosa Hall		
Meristella praenuntia Schuchert		
Stromatopora sp.		
Crinoid sp.	9	
More massive and granular, gray limestone, great numbers of small crinoid stems and branching bryozoa	13.5	
Nodular limestone, with many Favosites	5	
Nodular limestone, with few fossils, chert in thin layers 10 feet above base	45	
Concealed	20	
Granular limestone, with Favosites	2	
Concealed	15	

	Feet.
Gray limestone, like above, with brachiopods and bryozoa	3
Concealed	70
Coarse-grained, very nodular, gray limestone like above, dip E. 40 degrees	50
Shaly limestone	10 312+
Concealed	

Section Through Gap at Sector P. O.

	Feet.
Oriskany (333′)	
Non-cherty sandstone	150
Cherty sandstone and limestone	183
New Scotland (40′)	
Thick- to thin-bedded cavernous chert which weathers white on exposure	25
Slightly cherty, compact, light-gray limestone	15
Coeymans (50′)	
Granular crinoidal limestone	5
Concealed, probably limestone of Keyser age	45
Keyser (5′)	
Compact, dark-gray limestone, many Tentaculites	5
Concealed	

Approximate Thickness of Rocks at Baker School, East Part of Hardy County, Where Rocks are Nearly Vertical.

	Feet.
Chemung	2200
Portage	1200
Genesee	250
Hamilton	500
Marcellus	550

Rough Section of Selinsgrove Limestone at Fossil Locality No. 20, 0.5 Mile West of Old Fields.

	Feet.
Black shale with Styliolina fissurella in abundance, **Marcellus**	
Selinsgrove (60′)	
Calcareous sandstone and semicrystalline limestone, hackly weathering, many Ambocoelia umbonata	15
Green to gray calcareous shale	15
More limy shale with many fossils: Ambocoelia umbonata Conrad Leptaenisca australis Kindle Phacops cristata var. pipa Hall Atrypa reticularis (Linne) Anoplotheca (Coelospira) acutiplicata (Conrad) Striatopora sp. (Probably Onondaga in age)	30
Concealed	

Section of Selinsgrove Limestone 2.5 Miles Southeast of Moorefield Where Elkhorn Mountain is Cut By Moorefield River.

	Feet.
Black Shale of Marcellus	
Dark-gray rather impure limestone	85
Very black and very much crushed argillaceous and carbonaceous shale	30
Dark-gray, impure, rather shaly limestone, with 1′ layer made up almost entirely of Ambocoelia umbonata, about 20 feet below the top and many concretionary bryozoa or cup coral from 30 to 50 feet from the top	100

Section of Selinsgrove Limestone, Powderlick School.

	Feet.
Black shale	
Impure limestone	30
Calcareous shale	15
Impure limestone	10
Calcareous shale	25
Impure limestone	8
Calcareous shale	7
Impure limestone	5
Black shale	

Section of Selinsgrove Limestone, Moorefield-Reynolds Gap Road, 1.2 Miles North of Old Fields.

	Feet.
Massive, dark, bluish-gray, impure limestone with conchoidal fracture and few fossils	20
Same as above but with many small (1″ to 4″) calcareous and ferruginous concretions	3
Massive, impure limestone, many masses of spherical-shaped small concretions of pyrite and calcium carbonate	8
Gray calcareous shale	7
More massive, arenaceous, and calcareous shale	4
Shaly limestone	3
Compact, grayish-blue, impure, brown-weathering limestone, like top layer	20
Concealed, 20′ to	40
Black Shale, Marcellus	

Section of Genesee Shale, 2 Miles South of Petersburg, Grant County.

	Feet.
Portage	
Genesee (471′)	
Rusty to gray-weathering, platy and hackly, arenaceous and argillaceous shale, some Styliolina fissurella and pelecypods	22′
Slightly dark-weathering, arenaceous shale, with occasional 2″ sandstone layer	60
More sandy and dark-gray to green, arenaceous shale, somewhat wavy, with many fossils, Styliolina fissurella and smooth pelecypod	77

	Feet.	
Green-gray arenaceous shale, rather platy	50	
Arenaceous shale, slightly lighter in color	23	
Black arenaceous shale	79	
Black argillaceous shale	160	471

Hamilton Sandy Shale

The top 50 feet of rocks in the section carries Pterochaenia fragilis (Hall), Styliolina fissurella (Hall), and cf. Liopteria sp.

Shaly sandstone with surface markings of long lines and pits similar to ones seen on beach where wash from waves occurs. The middle and lower portion of the Genesee carries: Pterochaenia fragilis (Hall), Buchiola retrostriata (von Buch), Buchiola mariae Clarke, Probeloceras lutheri Clarke, Styliolina fissurella (Hall), Bactrites aciculum (Hall), cf. Pharetrella tenebrosa Hall, Buchiola sp., irregular-shaped concretions, many thin and elongated carbonaceous markings (plant remains).

Section Southeast Slope of South Branch Mountain Northwest of Needmore.

	Feet.
Catskill	
Portion with heavier sandstone beds, not including the top portion of the Catskill	2100
Less sandy portion of the Catskill. This part makes more gentle slopes and is less exposed, more shale	1800
Total	3900
Hendricks Sandstone	

Section Down West Slope of South Branch Mountain From Helmick Rock.

	Feet.
Pocono	
Very heavy sandstone of Helmick Rock cliff.	
Catskill (4755′)	
Upper gray sandstone portion (1400′)	
Concealed	200
Grayish to olive, brown-weathering, fine- to coarse-textured sandstone and dark, brownish-red, arenaceous shale in beds from a few inches to 30 feet, about as much sandstone as shale	1050
Olive to gray, brown-weathering and rather thin-bedded sandstone	150
Lower gray sandstone portion (3355′)	
Alternating beds of red sandstone and buff arenaceous shale in beds of about from 10 to 15 feet each, much concealed	335
Red sandstone and red arenaceous shale, in beds 5 to 30 feet, much concealed	520
Mostly alternating shales and heavier-bedded (25′+) sandstones, most of the shale dark-red and	

chunky-weathering, but some buff-colored. Most of the sandstones are red but some are green- and brown-weathering	750
Red sandstones and thicker interbedded shales, Less steep slopes here showing a higher percentage of shale, much concealed	570
Largely arenaceous shales of red and buff character, with an occasional red sandstone	600
Largely arenaceous shale with thinner bands of sandstone. Shales are as much gray and buff as red	160
Red arenaceous shales with few buff arenaceous shale layers	420
Total	4755

Chemung

Gray sandstones and shales, largely concealed.

FAUNAL DISCUSSION.

Fossils were collected from the different formations in Hardy County chiefly for the purpose of making correct formational divisions and only secondarily for the purpose of faunal studies. Many collections were made from the contact zones of Hamilton and Genesee, and Hamilton and Marcellus. A larger number of collections from these zones was necessary because of the difficulty experienced in the field of drawing these lines on lithological data in areas where these contacts, as in the Moorefield area, occur practically parallel to the surface and are frequently repeated. In the Helderberg, Oriskany, Niagara, Clinton, and Marcellus Formations a few collections were made for the determination of the faunal zones.

In the course of field work many observations were recorded concerning the occurrence of the better known fossils as seen in the rock. The table on pages 355-362 lists the occurrence of 221 different species of fossils collected from the various formations in Hardy County. A large percentage of these are from the Hamilton. No attempt was made to get a complete list of the fossils occurring in the various formations nor were many of the smaller species of Ostracods and Bryozoa determined. Dr. J. H. Swartz of the Department of Geology. University of North Carolina, assisted the author in the determination of the following collections: Nos. 2, 3, 4, 6, 7, 15, 16, 20, and 27. He is entirely responsible for the determination of fossils in lists Nos. 101, 102, 103, and 104.

Of the total thickness of a little over 15,000 feet of sediments exposed in Hardy County more than 7,000 feet, or about half the thickness, is practically without fossils and of the remaining portion about 3000 feet are but scantily fossiliferous. The formations which carry practically no fossils are: the Medina sandstones, the Bloomsburg sandstones, the Portage, and the Catskill. The following formations as exposed in Hardy County are sparingly fossiliferous: Martinsburg, Rondout, Bossardville, and Marcellus. The most fossiliferous formations are: the Hamilton, the Helderberg, and the Oriskany. In some of the limestone beds of Helderberg age, fossil remains constitute the larger percentage of the rock substance.

Of the 221 species of fossils studied, 125 are Brachiopods, 19 Pelecypods, 30 Gastropods, and the rest rather broadly scattered between the other invertebrate phyla.

No collections were made from the Martinsburg outcrop in the eastern part of Hardy County, although both the Lingula nicklesi and the Orthorhynchula linneyi zones were seen to be present, marking the Maysville division of the upper Martinsburg. Due to the arenaceous rather than the calcareous nature of the remaining exposed portion of the Martinsburg, comparatively few fossils are to be seen in the outcrop area. However, the Eden age is indicated by such fossils as: Diplograptus vespertinus, Dalmanella multisecta, Plectambonites rugosus, Cryptolithus sp., and Isotelus cf. stegops.

In Hardy County the contact zone between Martinsburg and the overlying Gray Medina or Oswego Sandstone was not seen, but in Pendleton County to the south the red weathering and fossiliferous sandstones of the Maysville seem to be transitional into the Gray Medina which is otherwise nonfossiliferous.

No fossils were seen in the Red Medina of Hardy County.

The White Medina has a few worm tubes (Scolithus) and trails (Arthrophycus) in the thinner sandstone beds just below the Clinton, but they do not seem to be as plentiful here as farther north in Mineral and Grant Counties, West Virginia, or in the Potomac River area of Maryland and West Virginia, where the Camarotoechia neglecta occurs also in some of the upper beds of the White Medina, giving evidence of the transitional character of the White Medina and the Clinton in such areas.

In eastern Hardy County, where the Clinton is best exposed, this transitional character is best seen in the McCauley section near Hanging Rock, page 250. In the western part of Hardy County as in many places in the counties to the south and west of Hardy there is a considerable gap between the top of the White Medina and the bottom of the Clinton. In fact a common occurrence is for the shales which normally lie between the Iron Sandstone of the Clinton and the White

Medina to be nearly or entirely lacking. In such cases the Tentaculites minutus subzone is brought down in contact with the massive Medina sandstones.

The Clinton rocks of Hardy County are much less fossiliferous than they are farther north and east along the Potomac and the fossil zones are less conspicuous. It is apparent, however, from the few exposures in the middle and upper part of the Clinton that the very resistant sandstone which occurs near the top of the Clinton is the equivalent of the Keefer Sandstone of the Maryland area. This sandstone is underlain by shales and thin-bedded sandstone carrying the Calymene clintoni fauna. Above the Keefer Sandstone bed the rocks are usually concealed, but in one locality (Elkhorn Mountain area) thin beds of calcareous and homogeneous sandstone, highly weathered, give evidence of an abundant fauna, apparently Rochester, though the layers seen were too much weathered to allow specific determination of the fossils. The fossils of the Clinton are marine in type and characteristic of the Clinton rocks to the north and east. The following forms were identified: Camarotoechia neglecta, Tentaculites minutus, Chonetes novascoticus, Calymene clintoni, Buthotrephis gracilis var., Orthoceras sp., Ostracods, several species, and Bryozoa, several species.

The "Niagara" of Hardy County (McKenzie of Maryland) is much less fossiliferous than the beds of the same age farther northeast. This is especially true of the lower portion of the "Niagara" which has so few fossils that it is not feasible to attempt its subdivision into faunal zones. Locally, limestone bands in the upper "Niagara" carry Camarotoechia andrewsi in as great abundance as do these beds in the Maryland and Pennsylvania areas. The Niagara formation in Hardy County has the same age in the upper portions as in the Maryland-Pennsylvania area to the northeast. This is also probably true of the lower portion but due to the scarcity of fossils, one can not be sure.

The Bloomsburg Red Sandstone is generally non-fossiliferous but locally some of the more argillaceous layers have numerous Leperditia alta and in some of the thin, sandy beds worm borings are common. Thus we find in the West Virginia Silurian red beds the same fossils as in the Bloomsburg of Maryland and Pennsylvania. It is probable, however, that the time occupied in their deposition was less than that of the thicker beds in the area to the northeast.

In places the Bloomsburg Sandstone is overlain by red and buff shaly beds which seemingly belong to the Bloomsburg rather than the Rondout above.

All exposures of the Rondout of Hardy County (Wills Creek of Maryland) are low in fossil content, but a few small collections were made. Species of Leperditia, chiefly Leperditia alta, occur sparingly throughout the formation. Toward the top in some places Camarotoechia litchfieldensis occurs in considerable numbers together with an occasional fragment of Eurypterus and more abundant Leperditia, chiefly Leperditia elongata.

The Bossardville Limestone as a whole is sparingly fossiliferous, although there are beds which carry great numbers of a few species of fossils, as for example Hindella congregata, Favosites niagarensis, Stromatopora cf. constellata. The Hindella congregata zone is well defined and occupies the middle and lower third of the formation. Camarotoechia litchfieldensis is common toward the upper part of the formation, especially in the western part of the county. In most places there is a well-developed Stromatopora bed about 100 feet above the base of the formation. Stromatopora reefs occur in different places from the middle of the formation to the base. Leperditia alta is common in some beds and ranges from near the base to near the top. Streptelasma sp. and Aulopora sp. are common in the Hindella congregata zone. No well-defined zone of Spirifer vanuxemi was found in Hardy County, although it does occur in Mineral and Grant Counties to the north and west of Hardy County. From the fossils as well as the lithology the Bossardville of Hardy County is to be identified with the Tonoloway of Maryland.

A complete list of the Bossardville fossils observed in Hardy County is: Stromatopora constellata, Favosites niagarensis, Hindella congregata, Hormotoma rowei, Leperditia alta, Leperditia sp., Camarotoechia litchfieldensis, Homeospira sp., Aulopora sp., Streptelasma sp.

The Helderberg is generally very fossiliferous and it is a comparatively easy matter to recognize its three chief subdivisions, which are from the base up: the Keyser, the Coeymans, and the New Scotland. The Becraft which is well developed in New York is not here represented. The upper half of the Helderberg, that is, the upper part of the Keyser, the Coeymans, and the New Scotland, is very much more fossiliferous than the lower portion of the Keyser. In places the Coeymans is practically made up of broken crinoid stems and brachiopods. The New Scotland Cherts are very porous from the leaching of the calcareous shells of brachiopods. In the lower portion of the Keyser there are beds in places with great numbers of Favosites and Bryozoa.

The basal portion of the Keyser near Ketterman School has a great abundance of the following species: Favosites helderbergiae, Halysites cf. catenulatus, Stromatopora cf. constellata. Just west of Bass P. O. the basal Keyser carries Camarotoechia cf. litchfieldensis, Diaphorostoma siluriana, Tentaculites gyracanthus, Aviculopecten sp., Whitefieldella cf. minuta.

None of these sections examined in Hardy County shows the entire thickness of the Keyser and no detailed collections were made except from the top portion of the Keyser in the Thrasher Spring School area. Here the Tentaculites gyracanthus and the Lower Stromatopora subzones are well developed. The Tentaculites subzone is well exposed at a number of localities. The fossils identified from the upper portion of the Keyser are: Favosites helderbergiae, Rensselaeria sp., Tentaculites gyracanthus, Favosites helderbergiae var. praecedens, Meristella praenuntia, Strophonella keyserensis, Stenochisma formosa, Stromatopora sp. In an exposure of the upper Keyser on High Knob the ground is strewn with weathered out and beautiful specimens of Favosites and Stromatopora.

The Coeymans is, everywhere in Hardy County, characterized by highly crinoidal limestones. The number of species of fossils occurring in these beds is, however, not numerous. One of the most common and characteristic forms is Gypidula coeymanensis. Other associated forms seen in some abundance are: Atrypa reticularis, Rhipidomella oblata, Spirifer octocostatus, Spirifer cyclopterus.

The New Scotland has a more abundant fauna in point of numbers of different species than the Coeymans. Here we find great numbers also of the same species. This is particularly true of Leptaena rhomboidalis, a fossil of very great range both geologically and geographically, but in no other formation in Hardy County is it so predominant. The most characteristic fossil as well as one of the most conspicuous in the New Scotland is the Spirifer macropleurus. Besides the two above-mentioned common forms, the following have been listed from the New Scotland of Hardy County: Dalmanella perelegans, Orbiculoidea discinisca, Spirifer cyclopterus, Spirifer concinnus, Spirifer perlamellosus, Eatonia medialis, Eatonia lirata sp. nov., Eatonia singularis, Meristella arcuata, Rhipidomella oblata, Hindia sphaeroidalis, Platyceras sp.

The Oriskany is unusually fossiliferous for a sandstone. This is especially true of the more calcareous portion toward the top. Brachiopods, pelecypods, and gastropods are the most common forms. Spirifer arenosus, Rensselaeria ovoides, Hipparionyx proximus, and Spirifer murchisoni are common and characteristic fauna. The Oriskany in Hardy County is readily divisible lithologically into two portions, an upper, non-cherty sandstone and a lower cherty, calcareous sandstone. The cherty, or lower Oriskany, corresponds to the Shriver of Maryland, while the non-cherty and upper Oriskany represents the Ridgeley of Maryland. The following forms have been identified from the Oriskany of Hardy County: Spirifer tribuarius, Spirifer tribuarius var. pauciplicatus n. var., Spirifer cumberlandiae, Spirifer paucicostatus, Spirifer intermedius, Spirifer angularis, Spirifer angularis var. tribulis n. var., Spirifer arenosus, Spirifer perdewi, Spirifer murchisoni, Hipparionyx proximus, Rensselaeria suessana, Rensselaeria ovoides, Platyceras gebhardi var. ventricosum, Platyceras cf. gracile, Stropheodonta sp., Meristella sp., Oriskania lucerna, Stropheodonta magniventra, Orbiculoidea sp., Lingula sp., Anoplotheca flabellites, Meristella lentiformis, Tentaculites elongatus, Leptaena rhomboidalis var. ventricosa, Schuchertella woolworthana, Schuchertella cf. becraftensis, Chonetes hudsonicus, Anoplotheca dichotoma.

The fauna of the Marcellus is largely of a dwarf character with the exception of some of the forms which occur in the more calcareous portion toward the base. Locally, as in the area to the northeast of Moorefield, these lower calcareous beds have a fauna which is suggestive of the Onondaga. The following forms have come from this lower portion: Ambocoelia umbonata, Leptaenisca australis, Phacops cristata var. pipa, Atrypa reticularis, Anoplotheca acutiplicata, Striatopora sp., cup coral sp., arm of starfish. The fossil content of the shaly, upper portion is less abundant than that of the calcareous, lower portion (Selinsgrove). The most abundant forms in these shales are: Liorhynchus limitare, Styliolina fissurella, Bactrites aciculum, Orbiculoidea sp., Lingula sp. Besides these forms there are occasional occurrences of: Liorhynchus laura, Buchiola halli, Ambocoelia umbonata, Probeloceras lutheri, and Loxonema sp. While the calcareous beds in the lower Marcellus carry a few Onondaga forms, they do not carry the Agoniatites and coral beds so characteristic of the Onondaga of central New York. It seems to the author that the Onondaga fossils which occur associated with the others of Marcellus and Hamilton character, point to a restricted sea condition in the West Virginia area during late Onondaga and early Marcellus time. In this area occur a few Onondaga species. It is logical to think of the lower or Selinsgrove portion of the Marcellus as of Marcellus age but having a few superannuated, migrant fossils from the Onondaga.

The Hamilton is very fossiliferous in the portions where it is calcareous, as near the base and to a greater extent near the top. The fossils are entirely of marine character and great variety. As would be expected the brachiopods are the predominant forms while pelecypods, gastropods and trilobites are very common. The following species have been observed from the upper portion of the Hamilton in Hardy County: Atrypa reticularis, Atrypa aspera, Atrypa spinosa, Athyris spiriferoides, Ambocoelia umbonata, Chonetes sp., Camarotoechia sp., Camarotoechia congregata, Lingula sp., Productella sp., Reticularia fimbriata, Rhipidomella vanuxemi, Spirifer consobrinus var. variplicatus var. nov., Spirifer mucronatus, Spirifer granulosus, Spirifer angustus, Stropheodonta inaequistriata, Stropheodonta sp., Schuchertella sp., Tropidoleptus carinatus, Actinopteria sp., Palaeoneilo sp., Fenestella sp., Diaphorostoma lineatum, Platyceras sp., Stereolasma rectum, Pleurotomaria sp., Phacops rana, Homalonotus dekayi, crinoid stem, Proetus macrocephalus, Orthoceras coelamen, Loxonema hamiltoniae, Tentaculites bellulus.

From the lower portion of the Hamilton the following forms have been listed: Cystodictya incisurata, Stropheodonta inaequistriata, Schuchertella variabilis, Chonetes setiger, Chonetes cf. mucronatus, Chonetes gibbosus, Chonetes vicinus, Chonetes cf. vicinus, Camarotoechia prolifica, Spirifer granulosus, Spirifer cf. audaculus, Spirifer angustus, Spirifer mucronatus, Spirifer consobrinus, Spirifer consobrinus var., Spirifer sculptilis, Reticularia fimbriata, Cyrtina hamiltonensis, Atrypa spinosa, Ambocoelia umbonata, Phacops rana, Homalonotus dekayi, Athyris spiriferoides, Athyris cora, Ambocoelia spinulosa, Ambocoelia cf. spinulosa, Meristella haskinsi, Meristella barrisi, Meristella sp., Atrypa reticularis, Eunella lincklaeni, Actinopteria sp. aff. decussata, Palaeoneilo cf. maxima, cf. Cyclonema hamiltoniae, Cyclonema sp., Cladochonus sp., Cornulites sp., Schuchertella variabilis, Stropheodonta textilis, Stropheodonta perplana, Stropheodonta cf. striatula, Rhipidomella cyclas, Rhipidomella cf. tullius, Tropidoleptus carinatus, Meristella cf. laevis, Buchiola halli, Cypricardinia indenta, Nucula corbuliformis, Orthonota parvula, Leda proutyi sp. nov., Paracyclas sp., Pleurotomaria sp., Orthoceras sp., Orthoceras constrictum, Orthoceras subulatum, fish scale, Loxonema hamiltoniae, Loxonema delphicola, Platyceras sp., Stereolasma rectum, cf. Diaphorostoma lineatum, Orthoceras sp., Chonetes sp.

It is to be seen from the above list of fossils that we have in Hardy County the representatives of a larger portion of the Hamilton as it occurs in New York. There is, however, a less number of pelecypods in the Hamilton of Hardy County than in the New York deposits or in the counties of West Virginia immediately to the northeast.

The Genesee, like the Marcellus, has a dwarf fauna consisting largely of thin-shelled pelecypods, cephalopods, and pteropods. Of these the most abundant are: Pterochaenia fragilis, Buchiola retrostriata, Styliolina fissurella, Bactrites aciculum. These species occur throughout the entire formation but are more abundant in the upper portion of the black shale and in the lower portion of the overlying thin-bedded gray sandy shales and sandstones. Besides the fossils listed above from the Genesee in Hardy County, the following have also been listed: Buchiola mariae, Buchiola sp., Probeloceras lutheri, Pharetella tenebrosa, Liopteria sp., thin and elongate carbonaceous markings (plant remains). The above list contains the more characteristic Genesee fossils of the New York occurrence.

The Portage beds which overlie the Genesee in Hardy County are practically without fossils and no collections were made from them. This absence of fossils has been utilized in the separation of the Portage from the Chemung and to a limited extent in connection with the lithological differences, in separating the Portage from the underlying Genesee.

The Chemung of Hardy County is sparingly fossiliferous. The calcareous and ferruginous sandstones of certain zones carry most of the fauna while the non-calcareous shales and sandstones are without fossils. No fossil collections were made from these beds in Hardy County but faunal field studies show that the Chemung is more fossiliferous in the middle and upper portion than in the lower. The following fossils were noted from the Chemung: Spirifer disjunctus, Atrypa reticularis, Camarotoechia contracta, Camarotoechia eximia, Tropidoleptus carinatus, Cyclonema multistriata, Loxonema sp., Schuchertella cf. chemungensis, Productella sp., Tentaculites sp. Crinoid stems occur in great abundance in thin sandstone beds throughout the Chemung but more especially toward the bottom of the formation, where their presence makes easier the drawing of the line between the Portage and the Chemung. The Parkhead member of the Chemung is not so well defined in Hardy County as it is in Mineral and Grant Counties to the west and in the Maryland area to the northeast.

The non-marine conditions which bring in the Catskill are seemingly initiated at an earlier time in Hardy than in the counties to the west so that there is an increase in the thickness of the Catskill and a corresponding thinning of the Chemung.

After the beginning of the continental conditions and the deposition of several hundred feet of the Catskill deposits (largely red shales) marine invasions occurred as is told by the recurrent Spirifer disjunctus fauna. In the eastern part of Hardy County such a Spirifer disjunctus horizon occurs about 1200 feet above the base of the "red beds."

With the exception of the recurrent Chemung fauna in its lower portion the Catskill is without marine fossils, but in many places there are poorly preserved plant remains.

Faunal Distribution by Formations.

	Catskill	Chemung	Genesee	Hamilton	Marcellus	Oriskany	New Scotland	Coeymans	Keyser	Bossardville	Rondout	Niagara	Clinton	White Medina	Martinsburg
PLANTS															
Buthotrephis gracilis var.													*		
Plant remains	*	*	*												
PORIFERA															
Hindia sphaeroidalis Duncan							*								
COELENTERATA															
Diplograptus vespertinus															*
Stromatopora sp.										*					
Stromatopora constellata Hall									*	*					
Cladochonus sp.				*											
Cup coral sp.					*	*									
Favosites niagarensis Hall										*					
Favosites helderbergiae Hall									*						
Favosites helderbergiae var. praecedens Schuchert									*						
Halysites cf. catenulatus (Linne)									*						
Michelina stylopora Eaton				*											
Stereolasma rectum Hall				*											
Streptelasma sp.										*					
Michelina sp.				*											
ECHINODERMATA															
Crinoid stem sp.		*		*						*			*		
Arm of Starfish?					*										
Pentremitidae sp.				*											
MOLLUSCOIDEA															
Bryozoa															
Aulopora sp.										*					
Cystodictya incisurata Hall				*											
Diplostenopora cf. siluriana (Weller)									*						

Faunal Distribution by Formations (Continued).

	Catskill	Chemung	Genesee	Hamilton	Marcellus	Oriskany	New Scotland	Coeymans	Keyser	Bossardville	Rondout	Niagara	Clinton	White Medina	Martinsburg
MOLLUSCOIDEA															
Bryozoa															
Fenestella sp.				*											
Ramose bryozoa							*								
Striatopora cf. cavernosa					*										
Brachiopoda															
Ambocoelia umbonata Conrad				*	*										
Ambocoelia spinulosa Hall				*											
Anoplotheca (Coelospira) acutiplicata Conrad					*										
Anoplotheca flabellites (Conrad)						*									
Anoplotheca dichotoma (Hall)						*									
Athyris spiriferoides (Eaton)				*											
Athyris cora Hall				*											
Athyris sp.			*												
Atrypa aspera Hall			*												
Atrypa reticularis (Linne)				*											
Atrypa spinosa Hall				*											
Centronella cf. ovata Hall				*											
Camarotoechia andrewsi Prouty												*			
Camarotoechia congregata (Conrad)				*											
Camarotoechia contracta (Hall)		*													
Camarotoechia congregata var. parkheadensis Swartz		*													
Camarotoechia litchfieldensis Schuchert										*	*				
Camarotoechia cf. litchfieldensis Schuchert									*						
Camarotoechia neglecta Hall													*		
Camarotoechia prolifica Hall				*											
Camarotoechia eximia (Hall)		*													
Camarotoechia sp.				*						*					
Chonetes gibbosus sp. nov.				*											
Chonetes cf. hemispherica				*											
Chonetes hudsonicus Clarke						*									
Chonetes lepidus Hall				*											

Faunal Distribution by Formations (Continued).

	Catskill	Chemung	Genesee	Hamilton	Marcellus	Oriskany	New Scotland	Coeymans	Keyser	Bossardville	Rondout	Niagara	Clinton	White Medina	Martinsburg
MOLLUSCOIDEA															
Brachiopoda															
Chonetes mucronatus Hall				*											
Chonetes novascoticus Hall													*		
Chonetes scitulus Hall				*											
Chonetes setiger (Hall)				*											
Chonetes vicinus (Castelnau)				*											
Chonetes sp.				*											
Coelospira sp.													*		
Cyrtina hamiltonensis Hall				*											
Dalmanella multisecta															*
Dalmanella perelegans (Hall)							*								
Dalmanella sp.				*											
Eatonia medialis (Vanuxem)							*								
Eatonia singularis (Vanuxem)							*								
Eatonia lirata sp. nov.							*								
Eunella lincklaeni Hall				*											
Gypidula coeymanensis Schuchert								*							
Hindella congregata Swartz										*					
Hindella cf. congregata Swartz										*					
Hipparionyx proximus Vanuxem						*									
Homeospira sp.										*					
Leptaena rhomboidalis (Wilckens)							*								
Leptaena rhomboidalis var. ventricosa Hall						*									
Leptaenisca australis Kindle					*										
Lingula aff. delia Hall				*											
Lingula nicklesi Bassler															*
Lingula sp.				*		*									
Liorhynchus cf. laura (Billings)				*											
Meristella cf. arcuata (Hall)							*								
Meristella barrisi Hall				*											
Meristella haskini Hall				*											
Meristella cf. haskinsi Hall				*											
Meristella cf. laevis Vanuxem				*											

Faunal Distribution by Formations (Continued).

	Catskill	Chemung	Genesee	Hamilton	Marcellus	Oriskany	New Scotland	Coeymans	Keyser	Bossardville	Rondout	Niagara	Clinton	White Medina	Martinsburg
MOLLUSCOIDEA															
Brachiopoda															
Meristella lentiformis Clarke						*									
Meristella praenuntia Schuchert									*						
Meristella sp.				*		*	*		*						
Meristina sp.													*		
Nucula corbuliformis Hall				*											
Orthorhynchula linneyi															*
Orthis cf. lepidus Hall				*											
Orbiculoidea sp.			*			*									
Orbiculoidea discinisca (Hall)							*								
Oriskania lucerna Schuchert						*									
Productella cf. spinulicosta Hall				*											
Productella sp.				*											
Plectambonites rugosus															*
Rensselaeria cf. suessana						*									
Rensselaeria suessana var. immatura Schuchert						*									
Rensselaeria sp.									*						
Reticularia fimbriata (Conrad)				*											
Rhipidomella cyclas Hall				*											
Rhipidomella cf. leucosia Hall				*											
Rhipidomella cf. oblata Hall							*	*							
Rhipidomella aff. tullius Hall				*											
Rhipidomella sp.				*											
Spirifer angustus Hall				*											
Spirifer arenosus (Conrad)						*									
Spirifer audaculus (Conrad)				*											
Spirifer angularis Schuchert						*									
Spirifer angularis var. tribulis var. nov.						*									
Spirifer consobrinus (d'Orbigny)				*											
Spirifer consobrinus var. variplicatus var. nov.				*											
Spirifer concinnus Hall							*								
Spirifer cumberlandiae Hall						*									
Spirifer cf. cyclopterus Hall								*							

Faunal Distribution by Formations (Continued).

	Catskill	Chemung	Genesee	Hamilton	Marcellus	Oriskany	New Scotland	Coeymans	Keyser	Bossardville	Rondout	Niagara	Clinton	White Medina	Martinsburg
MOLLUSCOIDEA **Brachiopoda** Spirifer cyclopertus Hall							*								
Spirifer disjunctus Sowerby	*	*													
Spirifer fimbriatus Conrad				*											
Spirifer granulosus (Conrad)				*											
Spirifer intermedius Hall						*									
Spirifer macropleurus (Conrad)							*								
Spirifer murchisoni Castelnau						*									
Spirifer mucronatus (Conrad)				*											
Spirifer cf. mucronatus (Conrad)				*											
Spirifer cf. octocostatus Hall								*							
Spirifer paucicostatus Schuchert						*									
Spirifer perdewi Schuchert						*									
Spirifer perlamellosus Hall							*								
Spirifer sculptilis (Hall)				*											
Spirifer sp.				*			*								
Spirifer cf. sculptilis Hall				*											
Spirifer cf. radiatus Hall													*		
Spirifer tribuarius Schuchert and Maynard						*									
Spirifer tribuarius var. pauciplicatus var. nov.						*									
Schuchertella variabilis Prosser				*											
Schuchertella woolworthana (Hall)						*									
Schuchertella cf. becraftensis (Clarke)						*									
Schuchertella cf. chemungensis (Conrad)		*													
Schuchertella sp.				*											
Stropheodonta inaequistriata (Conrad)				*											
Stropheodonta magniventra Hall						*									
Stropheodonta perplana (Conrad)				*											

Faunal Distribution by Formations (Continued).

	Catskill	Chemung	Genesee	Hamilton	Marcellus	Oriskany	New Scotland	Coeymans	Keyser	Bossardville	Rondout	Niagara	Clinton	White Medina	Martinsburg
MOLLUSCOIDEA **Brachiopoda**															
Stropheodonta striatula (Schlotheim)				*											
Stropheodonta textilis Hall				*											
Stropheodonta sp.				*		*				*					
Stenochisma formosa Hall									*						
Strophonella keyserensis Swartz									*						
Tropidoleptus carinatus (Conrad)		*		*											
Uncinulus sp.													*		
Vitulina pustulosa Hall				*											
Whitfieldella marylandica Prouty													*		
Whitfieldella cf. minuta Hall													*		
Whitfieldella sp.													*		
MOLLUSCA **Pelecypoda**															
Actinopteria aff. decussata Hall				*											
Actinopteria sp.			*	*											
Aviculopecten sp.									*						
Buchiola halli Clarke				*											
Buchiola mariae Clarke			*												
Buchiola retrostriata (von Buch)			*												
Buchiola sp.			*												
Cuneamya sp.												*			
Cypricardinia indenta (Conrad)				*											
Grammysia cf. arcuata (Conrad)				*											
Leda proutyi Swartz sp. nov.				*											
Liorhynchus laura Billings					*										
Liopteria sp.			*												
Orthonota parvula Hall				*											
Palaeoneilo cf. maxima (Conrad)				*											
Palaeoneilo sp.				*											
Paracyclas sp.				*											
Pterochaenia fragilis (Hall)			*												
Cf. Leptodesma rogersi Hall				*											

Faunal Distribution by Formations (Continued).

	Catskill	Chemung	Genesee	Hamilton	Marcellus	Oriskany	New Scotland	Coeymans	Keyser	Bossardville	Rondout	Niagara	Clinton	White Medina	Martinsburg
MOLLUSCA															
Pelecypoda															
Leptodesma rogersi Hall				*											
Gastropoda															
Bellerophon sp.				*											
Cyclonema minuta sp. nov.				*											
Cyclonema multistriata Clarke		*													
Cyclonema hamiltoniae Hall				*											
Cyclonema cf. hamiltoniae Hall				*											
Cyclonema sp.				*											
Diaphorostoma lineatum (Conrad)				*											
Loxonema hamiltoniae Hall				*											
Loxonema cf. hamiltoniae Hall				*											
Loxonema delphicola Hall				*											
Loxonema sp.		*		*											
Murchisonia sp.				*											
Platyceras minutum sp. nov.				*											
Platyceras gebhardi var. ventricosum Conrad						*									
Platyceras cf. gracile Ohern						*									
Platyceras sp.				*			*								
Platyceras cf. carinatus				*											
Pleurotomaria capillaria Conrad				*											
Pleurotomaria itys Hall				*											
Pleurotomaria sp.				*											
Hormotoma rowei Swartz										*					
Pteropoda															
Conularia sp.				*									*		
Pharetrella tenebrosa Hall			*												
Styliolina fissurella (Hall)			*	*											
Tentaculites elongatus Hall						*									
Tentaculites cf. bellulus Hall				*											
Tentaculites niagarensis Hall													*		
Tentaculites gyracanthus (Eaton)									*						
Tentaculites minutus Hall													*		
Tentaculites novascoticus Hall													*		
Tentaculites sp.		*													

Faunal Distribution by Formations (Concluded).

	Catskill	Chemung	Genesee	Hamilton	Marcellus	Oriskany	New Scotland	Coeymans	Keyser	Bossardville	Rondout	Niagara	Clinton	White Medina	Martinsburg
MOLLUSCA															
Cephalopoda															
Bactrites aciculum Hall			*												
Bactrites sp.			*												
Orthoceras constrictum (Vanuxem)				*											
Orthoceras subulatum Hall				*											
Orthoceras cf. subulatum Hall				*											
Orthoceras sp.				*	*										
Probeloceras lutheri Clarke			*												
Orthoceras coelamen Hall				*											
VERMES															
Cornulites sp.				*											
Worm Boring				*										*	
ARTHROPODA															
Isotelus cf. stegops															*
Homalonotus dekayi (Green)				*											
Dalmanites boothi (Green)				*											
Phacops rana (Green)				*											
Phacops cristata var. pipa Hall					*										
Proetus macrocephalus Hall				*											
Calymene clintoni Vanuxem				*									*		
Eurypterus sp.											*				
Ostracod sp.										*		*	*		
Bonnemaia sp.													*		
Leperditia alta (Conrad)										*					
Leperditia cf. elongata Weller											*				
Leperditia sp.										*		*			
Drepanella sp.												*			
Drepanellina sp.												*			
Eukloedenella sp.												*			
Fish scale				*											
Dignomia alveata Hall				*											

Geographical and Geological Position of Locality.

The following is a list of localities where fossil collections were made from the various formations in Hardy County. A table showing the fauna by localities was prepared but it was of such size it was found impracticable to publish it in its original form so the fossils identified were listed separately under the Locality Number and published under the description of the formation. The last column gives the page reference where the fossil list for each collection will be found in this Report:

Locality Number.		Page where Fossils are Listed.
1.	Hamilton, Lower. 3/4 mile northeast of Moorefield	316
2.	Hamilton. On road over hill, 1.5 miles southwest of Taylor	317
3.	Hamilton. On main road, 0.8 mile northwest of Fisher P. O.	313-14
4.	Hamilton. On main road, 0.8 mile northwest of Fisher P. O., and 300 feet northwest of Locality No. 3	314-15
5.	Oriskany, Upper. Same place as Locality No. 6, but higher in formation, by road, 0.6 mile southeast of Kessel	292
6.	Oriskany. Ridgeley. By road, 0.6 mile southeast of Kessel	292
7.	Hamilton. 500 feet northeast of Locality No. 16, about 1 1/4 miles northwest of Moorefield	315
8.	Hamilton. 1000 feet north of Locality No. 7, on river road, 1.45 miles northwest of Moorefield	316
9.	Helderberg. New Scotland. In road, 1/3 mile south of Turkey Mountain	283
10.	Helderberg. Keyser. In road, 1/3 mile south of Turkey Mountain	283
11.	Helderberg. Keyser. In road, 1/3 mile southwest of Turkey Mountain	283
12.	Bossardville. In road, 1/3 mile southwest of Turkey Mountain, 1.2 miles northwest of Kessel	272
13.	Bossardville. In road, 1/3 mile southwest of Turkey Mountain, 1.2 miles northwest of Kessel	272
14.	Genesee. About 2 miles south of Petersburg, just below big bend in public road	322-3
15.	Hamilton. Road west of South Branch, 1 1/4 miles northwest of Moorefield	317
16.	Hamilton. Just below Locality No. 15, near bend in road, 1 1/4 miles northwest of Moorefield	318
17.	Hamilton. From bluff just northeast of forks of road, 1 1/2 miles northwest of Moorefield	318
18.	Hamilton. On highway, 2 miles northwest of Moorefield	318
19.	Hamilton. On highway, 2 1/4 miles northwest of Moorefield	318-19
20.	Marcellus. Onondaga? Member. On road, 1/2 mile northwest of Old Fields	305

Locality Number.		Page where Fossils are Listed.
21.	Helderberg. New Scotland. 1.8 miles southeast of Williamsport	283
22.	Shriver Chert. No fossils. Cherty limestone. 1.8 miles southeast of Williamsport	292
23.	Oriskany. Ridgeley. 1.8 miles southeast of Williamsport	293
24.	Helderberg. Coeymans. Crinoidal limestone, just below New Scotland, 1.8 miles southeast of Williamsport	283
25.	Helderberg. Keyser. Tentaculites zone just below Coeymans, 1.8 miles southeast of Williamsport	284
27.	Marcellus. Onondaga? On Moorefield-Romney pike, 1 1/4 miles northeast of Old Fields	307
28.	Hamilton, Basal. Cut by railroad and highway, 1 mile southwest of Moorefield	316
29.	Hamilton? 0.4 mile west of Fisher	319
30.	Genesee. 1/2 mile southeast of Oakdale, about 4 miles southwest of Moorefield	323
31.	Bossardville. On second-class road over Mill Creek Mountain, 0.7 mile northwest of Glebe Station (Sector P. O.), Hampshire County	272
32A.	Niagara. On second-class road over Mill Creek Mountain, 1.1 miles northwest of Glebe Station (Sector P. O.), Hampshire County	256
32B.	Clinton. On second-class road over Mill Creek Mountain, near forks of road and gate, 1.2 miles northwest of Glebe Station (Sector P. O.), Hampshire County	252
33.	Hamilton. 3 miles west of Pancake, Hampshire County	319
34.	Bossardville. On second-class road, 7/8 mile northeast of High Knob	272
35.	Hamilton. On second-class road 3 miles southeast of Moorefield	319
36.	Hamilton. Moorefield-Petersburg road, 2 1/2 miles southwest of Moorefield	319
37.	Hamilton, Upper. About 1 1/2 miles northeast of Moorefield, by branch, north of highway	311
38A.	Hamilton, Top. By branch, north of highway, 1/2 mile northeast of Moorefield	311
38B.	Genesee, Bottom. By branch, north of highway, 1/2 mile northeast of Moorefield	323
39.	Chemung. On Moorefield-Wardensville road, 0.6 mile southwest of Sugarloaf Knob	329
40.	Hamilton, Top. On second-class road by Old Pine Church	312
41.	Hamilton, Top. By forks of second-class road along stream in Williams Hollow	312
42.	Hamilton, Upper. On second-class road 1/2 mile southeast of Mapleton	313
43.	Helderberg. Basal Keyser. Near Ketterman School, on public road	284
44.	Bossardville, Top. Near Ketterman School, on public road	272

Locality Number.		Page where Fossils are Listed.
45.	Niagara, Upper. 1.5 miles northwest of Brake	256
45A.	Clinton. From old ore pit by road, 1.5 miles northwest of Brake	252
46.	Helderberg. Basal Keyser. 1/4 mile northwest of Bass P. O.	284
47.	Niagara, Top. About 300 feet northwest from Locality No. 46, 0.3 mile northwest of Brake	257
48.	Rondout. Along same road as Localities Nos. 46 and 47, 1/4 mile northwest of Bass P. O.	262
49.	Hamilton, Upper. On second-class road, west slope of Elkhorn Mountain, 1 1/4 miles southeast of Durgon	320
50.	Hamilton, Upper. Moorefield-Petersburg road, about 0.6 mile east from Oakdale (Rig P. O.)	320
51.	Oriskany. At end of new highway bridge, opposite Welton	293
52.	Rondout, Top. 100 feet below Stromatopora bed of Bossardville, 1.4 miles southeast of Williamsport	262
53.	Bossardville. 23 feet below Stromatopora bed, 1.4 miles southeast of Williamsport	272
54.	Bossardville. 10 feet below Stromatopora bed, 1.4 miles southeast of Williamsport	273
55.	Bossardville. 3/4 mile south of Twin Mountain	273
56.	Clinton. From old ore pit by stream, on Grant County side of Grant-Hardy County line, 2.0 miles northwest of Brake	253
101.	Oriskany. Shriver. 141 feet below top of Oriskany, 1.7 miles southeast of Durgon	293
102.	Oriskany. Shriver. 272 feet below top of Oriskany, 1.7 miles southeast of Durgon	293
103.	Helderberg. New Scotland. 11 feet below Locality No. 102, 2.0 miles northwest of Bass P. O.	284
104.	Helderberg. Keyser. 110 feet below Locality No. 103, 2.0 miles northwest of Bass P. O.	284

CHAPTER IX.

MINERAL RE SOURCES.

PETROLEUM AND NATURAL GAS.

Hardy County's most western point is situated about 65 miles east of the nearest oil pool in the State at Shinnston, Harrison County, and is approximately 45 miles from the nearest gas production in Barbour County. Hampshire County's most western point is about 50 miles from the nearest gas production and the same distance as Hardy County from the nearest oil production. The easternmost points of these counties would be distant from the nearest oil production 100 miles (for Hampshire) and 94 miles (for Hardy), while to the nearest gas production the distances would be 85 and 76 miles, respectively. In the intervening territory, a few wells have been drilled, resulting mostly in dry holes with shows of oil or gas in some instances. To the northwest in Mineral County, a few holes have been drilled, but the tests were unfavorable, in most instances being shallow and the locations not as favorably situated structurally as might have been selected. In Grant County to the west of Hardy, two holes have been drilled, one just west of Steyer, to a depth of 2,240 feet, probably penetrating the Gordon Sand, while the second was drilled 0.4 mile northwest of Gorman to a depth of 3,500 feet, passing through the Elizabeth (Hendricks?) Sand. A little showing of oil was reported in the Steyer well in the Maxton Sand at a depth of 866-871 feet, while a note attached to the record states: "When 8 1/4-inch casing (620′) was lifted sufficient gas had collected to throw water out of hole for 45 minutes, but whether gas came from sandstone or coal it could not be determined." In the well near Gorman showings of oil were reported at 1,798 feet (in Berea? Sand) and at 2,723 feet in a gray sand not identified. About 35 miles southwest of Moorefield, a well was drilled at Riverton, Pendleton County, its depth on July 1, 1919, being 1,850 feet. Its record was published on page 272 of the Tucker County Report of the Survey. It is reported that some additional drilling has been done at this well but the record below 1,850 feet could not be obtained. It was most unfavorably located as a test for oil since the strata dip westward at an angle of 75 degrees or more, the surface outcrop being the black Marcellus Shales of the Devonian, while the Oriskany Sandstone crops on the river bank about 400 feet east of the well, with a visible thickness of 10 feet, and the Clinton (White Medina) Sandstone shoots vertically upward from the ridge one-fourth mile farther east, according to Reger. While drilled to a depth of 1,850 feet, the well could not have reached a stratigraphic level of more than a few hundred feet below the surface outcrop and, of course, did not reach sands which outcrop vertically east of the well. One deep well has been drilled in Tucker County at Parsons, about 38 miles S. 77° W. of the western corner of Hampshire and Hardy Counties. The total depth of the hole was 4,250 feet, penetrating 80 feet of Oriskany Sandstone, below which the hole was drilled 190 feet, where it stopped in another sand, but no thickness is given for the latter. Salt water was encountered in the Oriskany at 3,990 to 4,000 feet, while a gas pocket is recorded at 3,830 feet, in the Corniferous Limestone; another pocket of gas was reported in black shale (of Portage Series) at 1,093 feet, while a little gas was also recorded at 500 feet, in gritty lime (of Portage) and at 825 feet, in black sand (of Portage).

In Volume I(a) of the Survey by Dr. I. C. White, State Geologist, published in 1904, the following remarks concerning oil and gas prospects in "Mountain Regions" are given from page 63:

"In most mountain regions, the fracturing of the strata has been carried on to such an extent that all the available stores of gas and oil that may once have existed in the beds have passed out of the original reservoirs through their defective covers, escaping into the air, and hence it is useless to drill for oil or gas to any ordinary depth in typical mountain regions.

"It is barely possible that under a great thickness of close-grained beds or shales the gas and petroleum originally contained in rock reservoirs so situated may still be imprisoned. No borings in mountain regions have been sunk to a depth sufficiently great (4,000-5,000 feet) to test the truth of this supposition.

"The escape of the gas and all easily volatilized elements of the oil would render any remaining product so thick and viscous as to be unavailable except through mining operations as in the case of all asphaltic deposits which are only the residua of evaporated pools of petroleum. The great asphalt deposit at Trinidad is not in the crater of an extinct volcano as some geologists have stated, but is simply the asphaltic constituents of a great pool of petroleum comparable to Beaumont, Texas, or Baku, Russia, where the cover has been eroded and the volatile constituents of the oil have escaped."

In a special article on petroleum and natural gas by Dr. I. C. White published by Dr. J. M. Callahan in his Semi-Centennial History of West Virginia in 1913, referring to the eastern counties, he states that they "lie within the greatly disturbed region where the strata are highly crumpled, folded, and broken, so that whatever oil they may once have held has escaped into the air most probably in the form of gas or vapor through the heat generated in the earth movements giving origin to the folded, fissured, and broken strata." Concerning the possibilities of finding gas "in the counties east from the Allegheny Mountains, however," Dr. White states "the rocks are so tilted, fissured, faulted, and contorted that probably most of the gas they may once have held has long ago escaped into the air along with the petroleum."

In another article by Dr. White published in 1918 by John T. Harris in his Legislative Hand Book and Manual, page 677, referring again to the counties bordering on the State of Virginia, he writes: "The remaining counties of the State, being situated in mountainous regions where the stratified rocks have been highly folded, and in many cases even overturned, the oil and gas they may once have contained has practically all escaped into the air through fractures, faults, and other forms of rupture, so that except possibly at very great depths —5,000 to 10,000 feet—the chances of obtaining either oil or gas therein would be practically none whatever."

The highest rocks exposed in Hardy County are basal Pocono in age, occurring on South Branch Mountain from Helmick Rock northward about 8.5 miles, and on Short Mountain, from a point about 1.5 miles northeast of Needmore, to the Hampshire County line. All the oil and gas sands lying above the basal Pocono which are productive elsewhere in the State are not present in Hardy County. The lowest rocks exposed in Hardy County are those of the top portion of the Martinsburg Shale which outcrop in three different areas along the Virginia border. The sands which have been productive of oil and gas in other portions of the State or in other States occurring in the rock section exposed in Hardy County are shown in the following table:

Oil and Gas Horizons.

Devonian:	
Catskill Red Beds	Gantz Sand. Fifty-foot Sand. Thirty-foot Sand. Gordon Stray Sand. Gordon Sand. Fourth Sand. McDonald or Fifth Sand. Bayard or Sixth Sand. Elizabeth or Seventh Sand (Hendricks).
Chemung and Portage Beds	Warren First Sand. Warren Second (Burnside?) Sand. Clarendon or Tiona Sand. Speechley Sand. Balltown or Cherry Grove Sand. Sheffield or Cooper (Riley?) Sand. Benson, Bradford? or Deer Lick Sand. Elk or Waugh and Porter Sand. Kane Sand.

Devonian:	
Hamilton and Marcellus	Gas in Ohio and Kentucky.
Corniferous (Columbus) Limestone	Ragland, Menefee, or Irvine Sand of Kentucky.
Oriskany Sandstone	Oriskany Sand.
Silurian:	
Helderberg, (Devonian), Salina, and Niagara	"Big Lime" of Ohio (Newburg Sand near middle).
Medina White Sandstone	Clinton Sand of Ohio.
Ordovician:	
Martinsburg or Cincinnati Shale	Hudson Sand Group of Kentucky.
Trenton and Other Limestones	Trenton Sand Group of northern Ohio.

As a prospective oil or gas region, Hardy County is favored by the presence of the Devonian, Silurian, and Ordovician Rocks, the shales and limestones of which are known to contain abundant vegetable and animal remains from which oil and gas are admittedly distilled. Hardy County is further favored by folding which has developed well-defined anticlinal and synclinal structure so that any liquid hydrocarbon formed at an early age could have been fully segregated into pools. In many other fundamental conditions, however, it is lacking. From an examination of Map IV accompanying this Report, it will be noted that all the beds which produce oil and gas in abundance in the western part of the State have been elevated so high that their principal sands have been either eroded completely or outcrop at the surface so that complete evaporation would be possible. The only horizon mentioned in the table of oil sands on a preceding page which does not outcrop within Hardy County is the Trenton Sand Group which produces great quantities of oil and gas in Ohio and Indiana. Moreover, between the productive horizons in the western part of the State and the region of Hardy County there is no physical connection with the major portion of the sands since the great Deer Park Anticline, passing southwestward across Garrett County, Maryland, and Preston, Tucker, Randolph, and other West Virginia counties, brings above the surface nearly all the known productive oil and gas sands of the State. Some deeper horizons (Clinton) not yet proved to be productive in the western part of the State may exist as continuous sheets of sand eastward into Hardy County but little present significance may be attached to these deposits.

While there are no coals in Hardy County which would show the extent to which incipient metamorphism has taken place, the carbon ratio for eastern Tucker County by Reger showed 78 per cent., for the last isocarb line on the Grant County border. Calculations made by Tucker for Reger's Report on Mineral and Grant Counties showed variations from 77 to 83 per cent., increasing to the eastward. Reger's map showing isocarb lines in the State as a whole shows the economic occurrence of oil in the State to be limited to regions where the ratio is less than 60, there being a few pools between 60 and 65, and that gas in quantity has seldom been found where the ratio is above 70. The carbon ratio theory was first advanced by Dr. David White of the United States Geological Survey who showed that oil is seldom found in regions where the coals have extremely low volatile and high carbon content, and that gas in such localities is less abundant than in areas where the relative percentage of carbon is smaller, the explanation being that the analysis of the coal reveals the extent to which metamorphism has advanced and gives a criterion by which the same process in the petroleum hydrocarbons may be roughly measured. A carbon ratio for any point may be obtained by dividing the fixed carbon of the proximate analysis of a local coal by the sum of the fixed carbon and the volatile matter of the same analysis, which gives the total carbon contained in the coal on a moisture- and ash-free basis. "Isocarbs", or lines of equal carbon, may then be obtained by computing the carbon ratios for many points of a given area so that lines of average equal content may be drawn across the map of the territory so that the ratio for any point may be approximated. Since Hardy County lies eastward of Mineral and Grant which had a carbon ratio varying from 77 to 83, which is much greater than that of any of the known oil and gas fields of the State, this factor alone would indicate that the presence of either oil or gas in commercial quantity is extremely doubtful. The Adams Run, Anderson Ridge, and Sugar Knob Anticlines offer locations where shallow wells could be drilled to test the Trenton Sand Group, but as commercial ventures for profit they could not be recommended. The usual scums of oil on stagnant water were reported by the natives of Hardy County, but they turned out to be iron oxides, while reported gas seepages which some of the natives declared they had seen were not found, their locations still being a secret of the finder.

COAL.

The Coal Measure rocks do not occur in Hardy County. Some prospects for coal were encountered in the black shales of the Marcellus Series, but no coal was, of course, found. The Pocono Series was searched for coal since some impure beds of semianthracitic coal occur in the Pocono in Morgan

County, and also a little coal has been mined in Hampshire County to the north in the Hedges Shale on Short Mountain, but the beds remaining of the Pocono in Hardy County are several hundred feet below the portion of the Pocono (Hedges Shale) in which the Morgan and Hampshire County coals are found. The search, therefore, for coals in Hardy County should be discontinued since it will, no doubt, prove fruitless.

LIMESTONE.

The limestone resources of Hardy County are large and will no doubt be important from an economic standpoint in the not distant future. Limestone is probably the most valuable mineral commodity in the county which can now be offered to the markets of the country. They have not been utilized, however, to any great extent, except for local road building, and are therefore practically untouched. Some of the deposits of the county are located where they may be quarried to advantage near transportation, while other areas holding limestones of probably greater purity are removed from transportation and make their exploitation remote. The quality of the various limestone beds is shown by analyses given under the descriptions of the beds on preceding pages of this Report. They disclose that material is available from which there may be manufactured or derived natural cement, Portland cement, agricultural lime, railroad ballast, road material, concrete aggregate, and many other minor items. Owing to the presence of silica, alumina, and other less abundant impurities, the limestones of Hardy County are not in general adapted for use as blast-furnace flux, paper or glass manufacture, or for other purposes for which a strictly pure stone is demanded. The outcrops of the various limestones of the county are shown on Map IV accompanying this Report. An examination of this map discloses that the Helderberg Limestone has an outcrop of approximately 100 miles, the Bossardville of 115 miles, the Rondout of 67 miles, and the Niagara of 41 miles. The outcrops indicated vary from the bare thicknesses of the formations, in regions where the angle of dip approaches closely to 90°, to broad belts of 1.5 miles or more in width where the beds lie at a low angle, as is the case where the axes of anticlines coincide with the mountain ridges and the rocks have been eroded down to some calcareous formation. If all the limestone contained in these beds should be found useful, the quantity to be quarried would run into billions of tons. The limestone area of the county is marked usually by large orchards and rich farming lands and has long been famous for its fertility. Many fine orchards occur on the chert lands at the Helderberg-Oriskany contact. Some very fine springs occur in the Helderberg and Bossardville Limestones in various parts of the county. Some of these have been the source of marl deposits, the analyses of two samples collected by Tucker being given on a preceding page of this Report.

In any consideration of the possible use of Hardy County's limestones for Portland cement manufacture, it might be well to quote Dr. Grimsley's "conditions necessary for desirable cement mill locations" given on pages 504-5 of Volume III of the Survey:

"1. Materials (limestone or marl, clay or shale) of the correct composition must be present in sufficient quantity to supply a mill for a long period of time. A thousand-barrel plant will use about an acre of limestone, thirty feet thick, in one year.

"2. Amount of rock or soil cover should be comparatively small, the smaller the better, as a large amount of cover through the cost of its removal will make the cost of quarrying the materials too high.

"3. There should be a good water supply near at hand for steam purposes, use in the mill, and for fire protection.

"4. Cheap fuel, either gas or coal, is necessary. It requires about 200 pounds of coal or 2,000 cubic feet of gas to make a barrel of cement, including the fuel used for power, drying, and burning.

"5. There must be good transportation facilities by water, rail, or both, and the distance to large markets should be as short as possible in order to lower the freight rates. A barrel of cement weighs 400 pounds, so that an increase in freight rate of 50 cents a ton would increase the cost 10 cents a barrel. Companies prefer to have two competing lines of transportation available, but this condition is not essential.

"6. A good building site is necessary for the various buildings, and it should be large enough for the first buildings and for future additions as the industry grows. There should also be room for the railroad sidings. The building site should be near enough to the quarries to avoid long haulage, and at the same time far enough away to avoid any danger from blasting.

"7. If the cement materials are found above the site of the mill there will be an advantage in location, as gravity can be used in their delivery to the mill.

"8. Nearness to a town or city will often make it easier to secure laborers.

"9. The price of the land should not be placed at an exorbitant figure or it will prevent the location of mills where all the conditions are favorable."

A study of these conditions in Hardy County shows in general that there would be sufficient materials (1); at places the cover (2) would be slight; that along South Branch, Moorefield River, and Lost River there would be a good water supply (3); but condition No. 4, cheap fuel, either gas or coal, could not be met since all fuel of this nature would have to be shipped to the mill site; the transportation facilities (5) are hardly adequate except along South Branch where a small outcrop of the Helderberg and Bossardville could be reached at the county line west of the Trough, while the Helderberg, Bossardville, Rondout, and Niagara could be reached by the Baltimore and Ohio on Elkhorn Mountain southeast of Durgon, and the same limestones (except the Niagara) could be reached on Patterson Creek Mountain around Charles Knob from the same railroad north of Welton or northeast of Petersburg. Other areas on Patterson Creek Mountain would necessitate building 4 or 5 miles of railroad to reach the quarries. To reach the South Fork Mountain areas southwest of Elkhorn Rock, a line would have to be built up Moorefield River or the lumber railroad used or converted to standard gauge. The eastern part of the county has no railroad except the Winchester and Western ending at Wardensville, and extensions up Lost River, Trout Run, and Waites Run would be necessary to reach the limestone deposits in that area. Transportation by water is not feasible. Building sites (6) would be available in many places and if the quarries are opened near the river bottoms there would be plenty of room for railroad sidings. Gravity can be used in many instances since there are many locations where the cement materials could be found above the site (7) of the mill. Condition No. 8, nearness to a town or city, however, could not be met at present, since there are only three towns of any size in the county, Moorefield, Wardensville, and Lost City, but good roads built and building would overcome to a large extent the necessity for locating near these towns in order to get laborers. Moorefield is about 4.5 to 5 miles from the nearest Helderberg Limestone outcrop, while it is a little over 2 miles from Wardensville to the nearest crop of the same limestone. The price of land (9) in Hardy County, except for the rich bottom lands and the orchard lands near the Oriskany-Helderberg contact, would not be prohibitive, either for mill or quarry sites.

Limestone has been used locally at many points in the county for agricultural lime and road material. These will probably be the main uses of the limestones of the county for many years to come.

GLASS-SAND.

In Volume IV of the West Virginia Geological Survey by Dr. G. P. Grimsley, pages 376-8, the requirements of a glass-sand for different grades of ware are quoted from E. F. Burchard in a Bulletin (285, page 453, published in 1905) of the United States Geological Survey. Some simple methods for a preliminary examination of glass-sands are also suggested. His notes on these subjects are herein included and should prove of interest and value to those interested in glass-sands:

"To the sand is due the absence of color (according to its purity), the transparency, brilliancy, and hardness of glass. In other words, the quality of the glass depends largely on the quality of the sand. For the finest flint ware, such as optical and cut glass, 'water whiteness', absolute transparency, great brilliancy, and uniform density are required, and only the purest sand can be employed, since slight impurities, especially small quantities of iron, tend to destroy these effects. For plate and window glass, which are commonly pale green, absolute purity is not so essential, but generally the sand should not carry more than two-tenths per cent. of ferric oxide. Green and amber glass for bottles, jars, and rough structural work can be made from sand relatively high in impurities. An excess of the chief impurity, iron, is usually avoided in the quarries by a careful selection of the whitest sand, although the whitest sand is not invariably the purest. Repeated washing tends to remove the iron. Clay materials are objectionable because they cloud the glass. Washing helps to remove them, since they occur usually in a very finely divided state. Magnesia, which is more apt to be introduced into glass materials through limestone than through sand, is troublesome because it renders the batch less fusible. If the sand is derived from industrial sandstone, the latter should be friable or easily crushed.

"In examining sand, in order to ascertain its value for glass-making purposes, inspection with a magnifying glass is the best preliminary test. The following points should be observed: The sand should be nearly white in color; it should be of medium fineness (passing a 20- to 50-mesh horizontal sieve); the grains should be uniform in size, even and angular, or less preferably, they may be rounded. A simple chemical test may be employed by heating the sand in a dilute acid. Effervescence indicates the presence of lime, loss of color shows the presence of clay impurities. Iron in the most minute quantity may be detected by dissolving sand in hydrofluoric acid and adding potassium ferrocyanide, which produces a blue precipitate if iron is present. Complete quantitative analyses as well as a furnace test should be made as a final determination of the character of a prospective glass-sand. * * * * Sand uniformly finer than one-sixtieth inch is said to burn out in the batch and not to produce as much glass per unit of weight as does coarser sand. In a mixture of coarse and fine sand the finer sand is liable to settle to the bottom of the batch thus preventing an even mixture of the materials and producing in consequence a glass uneven in texture."

Glass, chemically, is a fused mixture of alkaline silicates, alkaline earths, and metals; or, in other words, it is usually a sodium lime silicate. Linton, in Mineral Industry, Volume 8, pp. 244-5, 1899, gives the proportions by weight of the different ingredients in various kinds of glass:

	Plate Glass.	Window Glass.	Green Bottle.	Lead Flint.
Sand (SiO_2)	100	100	100	100
Salt cake (Na_2SO_4)	---	42	38	---
Soda ash (Na_2CO_3)	36	---	---	---
Limestone ($CaCO_3$)	24	40	34	---
Carbon (C)	0.75	6	5	---
Arsenic (As_2O_3)	1	2	---	0.15
Potash (K_2CO_3)	---	---	---	34
Red lead ($2PbO+PbO_2$)	---	---	---	48
Niter ($NaNO_3$)	---	---	---	6
Manganese (MnO_2)	---	---	---	0.06
Antimony (Sb)	---	---	---	0.02

From this table, sand is seen to be the most important component in quantity, forming 52 to 62 per cent. of the mixture. In Hardy County, there are two sandstones which may possibly be used for glass-sand at some future date, the Oriskany and the White Medina. In both of these, however, certain layers of the rock are composed almost entirely of rounded pebbles. These layers could not be used for glass-making since the more fusible sand would be burned up in applying enough heat to melt the pebbles. The Oriskany Sandstone also contains some iron which would have to be removed by washing. In the Hancock plant in Morgan County, the pebbles are removed and sold for use in pebble asphalt roofing. The impure sand from this plant is sold as engine sand. The float sand and clay are sold to fire brick factories. Chemically, the sand for glass-making should contain a high percentage of silica, not less than about 99 per cent. In order to secure the best results the grains of sand should be angular rather than rounded. The rounded sand grain is apt to settle to the bottom of the retort and not give a uniform mixture. Iron, which is always present in the rock materials, is neutralized somewhat in the glass-furnace by the addition of cobalt, arsenic, antimony, nickel oxide, or manganese. The No. 1 sand of the Hancock plant shows the following on analysis in the laboratory of the Survey:

	Per cent.
Silica	99.60
Iron oxide	0.0286
Alumina	0.4214

To successfully compete with sand of this character, it would be necessary to locate the rock layers approaching the above chemical composition. The analysis of a sample of the White Medina, given on a preceding page (248) of this Report, showed a silica content of 97.34 per cent.; ferric iron 0.86; alumina 0.94; lime 0.36; and loss on ignition 0.64. The silica content in this sample is thus seen to be under the 99 per cent. silica requirement for the best results. The iron is also high, but could possibly be lowered somewhat by washing. One sample of the Oriskany Sandstone was collected by Tucker and its analysis is given on a preceding page (299) of this Report. The silica content was 96.10 per cent.; ferric iron 0.88; alumina 1.12; calcium carbonate 1.33; and loss on ignition 0.82. This sample is also low in silica and high in iron. The cherty layers of the Oriskany could not, of course, be used for glass-sand, but the softer Ridgeley member, from which the above sample was taken, might be used if the impurities can be reduced by washing. The freight rate to the glass centers and the cost of crushing and washing and transporting to the railroad would be the final determination as to whether or not the Oriskany and White Medina Sandstones could enter into competition with other sands more favorably situated and enjoying a better freight rate. Some difficulty was encountered in using the White Medina Sandstone in Morgan County owing to its hardness, since it all had to be crushed and thoroughly ground, and even then it did not separate into grains, but broke into fragments of various sizes, much being reduced to a powder. The product from that quarry was reported not so suitable for high-grade glass, and the greater amount of grinding necessarily adds to the cost of production. The rock, however, was very pure, showing 99.96 per cent. silica, 0.06 per cent. iron oxide, and 0.23 per cent. alumina.

Should the sand from the Oriskany and White Medina prove acceptable to the glass manufacturers, the quantity would be inexhaustible, since the Medina outcrop is about 48 miles long in the three areas in which it occurs in Hardy County, while the Oriskany has an outcrop of approximately 160 miles in the various areas in which it occurs. The thickness of the Medina in Hardy County varies from 250 to 400 feet, while the Ridgeley member of the Oriskany varies from 100 to 150 feet.

IRON ORE.

In 1909, the West Virginia Geological Survey published Volume IV, on Iron Ores, Salt, and Sandstones, by Dr. George P. Grimsley. Chapter VIII of that report was headed "The Iron Ores of Hardy and Hampshire Counties", and from which the following descriptions of the various openings and prospects are taken, pages 208 to 245, and the insert table at page 280 giving the analyses of the samples of ore taken by Dr. Grimsley, omitting pages 201 to 207 of the Chapter mentioned in which the Geography, Topography, Geology and Structure were discussed, these items being described in more detail in the present report. Figures 9 and 10 of Volume IV are reproduced as Figures 18 and 19 of this report, while three of the plates published in that volume are also reproduced, the others not being available at the present time.

Dr. Grimsley also gives on page 208 a short "Bibliography" on the iron ores, as follows:

"The Iron Ores of Hampshire and Hardy Counties.

"**Bibliography.** W. B. Rogers in his Geological Reports 1835-1841 gives a number of notes on this area and includes a number of cross-section structural profiles. Maury and Fontaine in 1876 include in the Centennial report an account of the iron ores. In 1906 the writer made a report on the iron ores in the eastern part of Hardy and southeastern portion of Hampshire County, for eastern parties who have kindly given permission to use these notes and analyses in the present report. Mr. John Fulton in 1880 made an expert report on the ores in the Moorefield region.

"MINES AND PROSPECT OPENINGS.

"In the Moorefield area a number of prospect openings were made 20 or 30 years ago and an incorporated iron company organized at that time still controls the ore lands on Middle Mountain. In the Upper Lost River Valley some attention has been paid to these ores, but very few openings have been made. In the Wardensville area, three furnaces were formerly in operation, two of which are standing. To supply these plants numerous mines were opened and prospect pits were made in all directions so that more exposures of the ore are found than in any other section of the State. The last furnace run was made in 1882, over 25 years ago, (1906) and in that time the shafts have caved or filled with water, the old tunnels and entries have fallen shut, and the sides have caved in the open cuts. When these pits were examined in 1906 very little of the ore could be examined, but during the past year many of these places were reopened and new openings were made which permitted more complete examination. All of these recent openings are shallow, work being stopped in most cases when the ore was struck. No drilling has been done so that the depth can not be determined. It is very probable that more extensive work and deep drillings will be made in the near future as the property is under option.

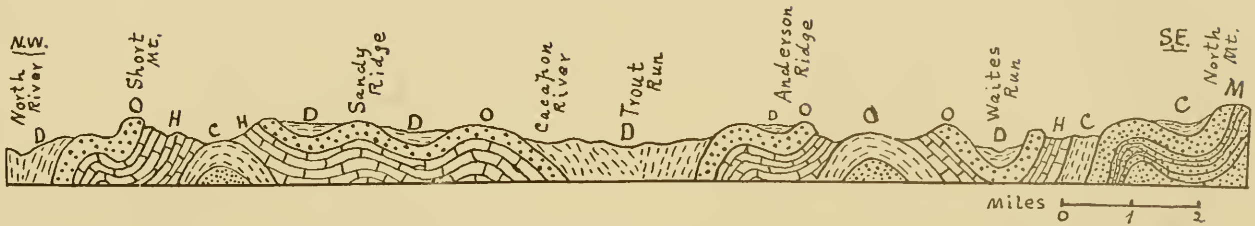


Figure 18. Geological Section across Northeastern Hardy County (after Rogers).

D. Hamilton Shale. C. Clinton.
O. Oriskany sandstone. M. Medina
H. Helderberg limestone.

NOTE: This cross-section is reproduced to show the ea rly work of Prof. Rogers in 1835-1841 and does not correspond to the formations as identified in this report. The ma in differences are at the northwestern end of the section. Short Mountain is synclinal and in the Pocono Series, and there al so seems to be an excess of Hamilton. The Medina was correctly identified in North Mountain at the eastern end of th e section.—R. C. T.)

"This North Mountain ore belt has been followed northward into the southern part of Hampshire County, but with no openings into the ore body. Farther north at Bloomery an old furnace is standing, but the ore mines were mainly shafts and tunnels which have caved. The few places in this section visited showed nothing at surface except loose boulders, and the overseer of the furnace property claimed that all of the old workings had fallen shut and that it was impossible to study the ore. The ore at the old furnace dump was sampled and showed the following composition:

	Per cent.
"**Metallic iron**	**42.63**
Moisture	0.54
Loss on ignition	7.98
Silica	25.02
Iron oxide	60.90
Lime oxide	0.45
Manganese dioxide	0.01
Sulphur	0.09
Phosphorus	0.25
Titanium oxide	0.14

"According to reports of men in this region the ore bodies were scattered and very variable in grade. The ore on the dump near the furnace is honeycomb in structure and only of fair grade. It seems probable that ore of good grade is to be found, but it will require prospect work in form of excavations and drilling to prove the value of this region. The various mines and prospects will now be described.

MOOREFIELD AREA

"**McMicken Prospect in Clinton Ore.**—On the eastern slope of Middle Mountain which is the northern portion of the South Fork Mountain about 7½ miles southeast of Moorefield on the Baker land, McMicken and Co. opened a small prospect in the Clinton red fossil hematite some years ago. The location is near the head of a small ravine and on its south bank, about three-fourths mile east of the house of John Wolff and 480 feet lower, or about 1,700 feet above sea.

"The bed of red hematite dips about 16 degrees northeast. The ore breaks with joint-planes N. 10° W. and east and west, and the shows the following strata:

	Feet.	Inches.
"Shales	4	..
Brownish sandstone	6	..
Shales	1	..
Red shales	0	10
Sandy ore	0	6
Red hematite	1	2

160 feet higher is a heavy ledge of hard yellowish-white sandstone.

"The ore is thus 18 inches thick and has been opened for a distance of about 20 or 30 feet and its outcrop in the form of loose blocks has been found farther north. While the outcrop is of doubtful economic importance unless a larger bed is found, it is of interest as indicating the continuation of the Clinton red hematite found in the South Fork Mountain in Pendleton County. Its composition is given in the following Survey analysis:

	Per cent.
"**Metallic iron**	**44.46**
Moisture	0.50
Loss on ignition	10.75
Silica	8.30
Iron oxide	63.52
Lime oxide	10.35
Manganese dioxide	0.035
Sulphur	0.019
Phosphorus	0.48
Titanium oxide	0.07

"**Burns Knob Prospect.**—One mile and a half southwest of the John Wolff house, 140 feet higher, on a high knob locally called Burns Knob on the Nick Baker land now owned by the Moorefield Iron Co., about 9 miles from Moorefield, openings have been made in the brown hematite.

"The ore was opened by a trench 12 to 15 feet deep running east and west about 30 feet long. A second trench just to the east, almost in line with the first, is 25 feet long. The ore opening shows 5 feet in depth but it is still in ore, so that depth is unknown. At this place the cover consists of 12 to 15 feet of shales. To the south about 400 feet is an outcrop of heavy white sandstone. Farther south is a high cliff of the same sandstone rising to 115 feet above the ore in the trenches. This sandstone is a close-grained white rock with no trace of fossils, representing one of the Medina sandstones, and the ore is a brown hematite in the Clinton shales and clay.

"This ore is deep chocolate brown color with botryoidal surface very characteristic. The ore is coated with these raised round globular masses and pipes. The surface exposure of the ore is in boulders but becomes solid below, and is apparently very uniform in texture and quality which is of high grade. It has the following composition according to the Survey analysis:

	Burns Knob. Per cent.	Fisher Farm. Per cent.
"**Metallic iron**	**52.70**	**53.14**
Moisture	0.14	0.24
Loss on ignition	9.71	10.14
Silica	13.81	10.48
Iron oxide	75.28	75.92
Lime oxide	0.22	0.46
Manganese dioxide	0.04	0.035
Sulphur	0.007	0.001
Phosphorus	0.26	0.15
Titanium oxide	0.01	0.07

"**John C. Fisher Farm.**—On Middle Mountain above and to the east of the John C. Fisher house, seven miles southwest of Moorefield, is a second group of prospect openings in this brown hematite 500 or 600 feet above the valley.

"The ore was opened in several pits and a long trench excavated in an east and west direction up the hill. The west wall is limestone which shows also to the south. The second ore is associated with flint fragments in large quantity. A second trench was driven for 200 feet in a north and south direction. The width of the vein is about 14 feet as shown by these trenches. The deep trench shows ore, shale and flint in its entire depth of 25 feet which has apparently reached the main ore body, and represents the Oriskany horizon.

"The ore has a honeycomb structure with considerable dirt through it, and is light to dark brown in color.

"Loose blocks of the limonite ore are found along this mountain at a number of places, but these two openings are the only prospects There appears to be along this slope of the mountain a large body of ore which will probably be at least three miles long with an average width of 12 to 14 feet. Its depth has not been determined but from the records to the south in Virginia, it will probably reach at least 100 feet with possibility of reaching even greater depth. These figures would represent an available ore supply of 1,390,000 tons. This ore has not been reported from the western slope of this mountain, though careful prospect work may reveal its presence in that area. The above estimate is founded on uncertain data and only represents the possibility as it will require much more prospect work to finally decide the quantity of ore.

"**South Branch Mountain.**—At various points along the slopes of the South Branch Mountain to the east of Moorefield, blocks of brown hematite are reported as present in considerable quantity. The ore is found in loose blocks and no prospect openings have been made to determine the exact location of the bed, but there are indications of considerable deposits of this ore. On the land of Mr. Brawl, six miles east of Moorefield, the brown hematite ore is said to occur in quantity in form of loose blocks.

"On the Joseph D. Ruckman farm on the hill a quarter mile to to south of the Wardensville road, nine miles east of Moorefield the ground is covered with loose blocks of ore but no prospects have been opened to determine the ore in place. From its association it is apparently the Oriskany horizon, and the ore is of good quality, but it is impossible to determine its extent. The boulders trend along a northeast-southwest line. Farther down the road the wall of light gray sandstone runs N. 45° E. andd here shows five feet of ore with the following composition:

	Per cent.
"**Metallic Iron**	**31.96**
Iron oxide	45.65
Silica	34.41

"The slopes of this South Branch Mountain with its scattered ore blocks may prove rich in brown hematite ore, but like the localities in Grant County, it will require careful prospect work in numerous openings to prove its value in ore.

"The eastern slope of Patterson Creek Mountain, or as it is locally called, Orr's Mountain, shows the Oriskany-Helderberg contact, and here and there are scattered blocks of ore which would indicate ore bodies along its eastern slope in Hardy County. There is also the possibility of finding brown hematite ore deposits along the slopes of Mill Creek Mountain from a point seven miles north of Moorefield to Romney in Hampshire County.

"To the east of South Branch Mountain in Short Mountain, loose blocks of brown hematite ore are also reported, and an old furnace was in operation there many years ago.

"When the eastern part of Hardy County with its rich ore prospect openings is compared with the evidence of ore in the western part where almost no openings have been made, there is certainly much encouragement for valuable deposits in the Moorefield vicinity, but this development work should be carried forward until there are as many openings in the ore as at the east. If the farmers would open the ore on their own lands during the spare time of the winter or other time, the careful prospect work would add to the value of their land. The people should not be satisfied to merely know that in fields and on mountain slopes they can find loose boulders of ore, thereby reaching the conclusion that whole hills of iron exist. The ore should be opened so that a possible investor can actually see the ore in place and not have to make a guess as to its existence in commercial quantity. Instances have been found where the land has been held at very high price because of these ore boulders, and where no facts were available as to real quantity or value of ore. A small body of ore will furnish a large number of boulders which may roll down a slope some distance giving the appearance of a wide deposit. In such prospect work it should be remembered that these heavy ore boulders do not roll up hill, so in looking for their probable source the line will not be below the highest line of boulders. Again the trend of the ore bodies is almost without exception north 20° to 40° east, so a trench dug to locate the ore body should be made at right angles to this direction and carried for some distance and to some depth. When the ore body is once found then it may be followed by pits along the northeast or southwest line to determine the length. It is unfortunate that at the present time in all the Moorefield region three or four prospect openings include all the work on these ores, when there is so much encouragement for prospect work.

"LOST RIVER AREA.

"Lost River post-office on Lost River is 11 miles southwest of Moorefield across the South Branch Mountain, or 20 miles by the road across this mountain. It is 23 miles byy road southwest of Wardensville.

"In the Cove Mountains to the south and east of Lost River P. O., and Mathias, the slopes of the mountains show iron ore boulders over most of their distance. These are abundant on the J. Ward Wood land on Lower Cove Mountain and in the Upper Cove. The bed could not be found in place, but the number of large boulders of brown hematite would indicate an extensive deposit on both slopes of the mountain. The sides of the mountain are here thickly covered with the large boulders of Oriskany Sandstone covering the ground and filling the ravines so that they can only be traversed with difficulty on foot. A careful search was made for the ore bed in a trip from the west slope across the mountain and along the sides of this mountain, but it could not be found in place. The distribution of the ore boulders shows that the outcrop is somewhere near half-way up the mountain.

"The composition of this float ore on the J. Ward Wood land is shown by the following Survey analysis:

	Per cent.
"**Metallic iron**	**50.96**
Moisture	0.27
Loss on ignition	8.83
Silica	12.44
Iron oxide	72.80
Lime oxide	0.40
Manganese dioxide	0.47
Sulphur	0.023
Phosphorus	0.41
Titanium oxide	0.18

"**Strausman Farm.**—About two miles east and south of J. Ward Wood's house at the foot of Cove Mountain on the Riley Strausman farm the boulders of brown hematite ore are found with limestone to the east and the Medina Sandstone to west. The limestone ledges trend N. 25° to 30° E. The position of the bed can be here closely approximated from the relation of the sandstone outcrop to the limestone, and the ore boulders follow along this line but the ground is strewn with large sandstone blocks and no openings have been made. The ore is reddish-brown in color with somewhat porous structure and near the sandstone has inclusions of sand. Fragments are found adhering to the sandstone wall. The age of the limestone is somewhat uncertain as no fossils were found and it may represent the Shenandoah limestone,* making the ore Silurian probably included in the Clinton series.

"**Bear Wallow Ridge.**—To the southwest of the last on Bear Wallow on the Keller farm is a well-marked ridge of brown sandstone trending N. 40° E., and dipping 30 degrees in a direction N. 50° W. and apparently forming the hanging wall of the ore. The sandstone apparently forms the crest of the ridge with the ore body pass-

*The Shenandoah Limestone does not outcrop in Hardy County. Limestone referred to is probably in the Salina Group.—R. C. T.

ing under it, and ore is found to the east and west of this sandstone cap. The lower portion of the sandstone has ore adhering to it and penetrating it, in stringers.

"From the surface exposures of the ore and the distribution of the large ore blocks, the bed is probably at least 15 feet thick, but it may be even greater. The ore is reddish brown in color, with some blocks a light brown, and contains glistening black areas. It breaks irregularly shaly, and contains few cavities. Its appearance and association are similar to the ore on the Strausman farm and it doubtless represents the same bed as blocks of same kind of ore are found on the mountain between the two places. The chemical composition of the ores from the Strausman and the Bear Wallow Ridge on Keller farm is shown by the following Survey analyses:

	Strausman. Per cent.	Bear Wallow. Per cent.
"**Metallic iron**	**39.20**	**44.69**
Moisture	0.10	0.29
Loss on ignition	11.35	6.66
Silica	35.86	21.63
Iron oxide	56.00	63.84
Lime oxide	0.08	0.16
Manganese dioxide	0.017	0.04
Sulphur	0.000	0.02
Phosphorus	0.23	0.39
Titanium oxide	0.07	0.21

"This bed was followed to the southwest over a half mile, and is found farther south in an outcrop on the county road, also to the west on Saw Log Ridge, and on the Big Ridge northwest of Mathias. Brown hematite ores are reported on the west slope of the North Mountain to the east and southeast of Mathias. This Lost River area contains a number of deposits of excellent brown hematite ores, but the ores have not been prospected and no openings have been made in them. The ravines where the outcrop should be exposed by erosion are filled with the large sandstone blocks so that in this area it is impossible to accurately estimate the tonnage. Higher on the slopes of the Cove Mountains is the compact white sandstone of the Medina, but the ore examined is below the brown sandstone. There may be a second ore body between the white and brown sandstones similar to the deposits in eastern part of the county. Indications of this ore body in form of blocks were found on the J. Ward Wood farm, but along this portion of the mountain the blocks of sandstone are so numerous that very few other rocks are found.

"The area well deserves exploitation and the ore bodies should be opened. Across the North Mountain in Virginia, only a few miles distant the ores are regarded as very valuable and have long been mined for use at the Liberty Furnace. There is certainly a large deposit of brown hematite ore below the brown sandstone on the eastern slope of the Cove Mountains, with a possible second important ore body above this sandstone and below the white sandstone. The lower horizon can be followed for nearly five miles, and with width of 15 feet and an assumed depth of 75 feet, would yield 2,500,000 tons of ore.

"In a farm road across the J. Ward Wood land in the Lower Cove a bed of red hematite, compact in texture, was observed in buff shales with a northeast trend, but its width could not be determined. Its outcrop is claimed to be traced for a mile and was followed near the road for 300 feet. No openings have been made in it, but if it should be found wide enough for economical working would prove an important ore body.

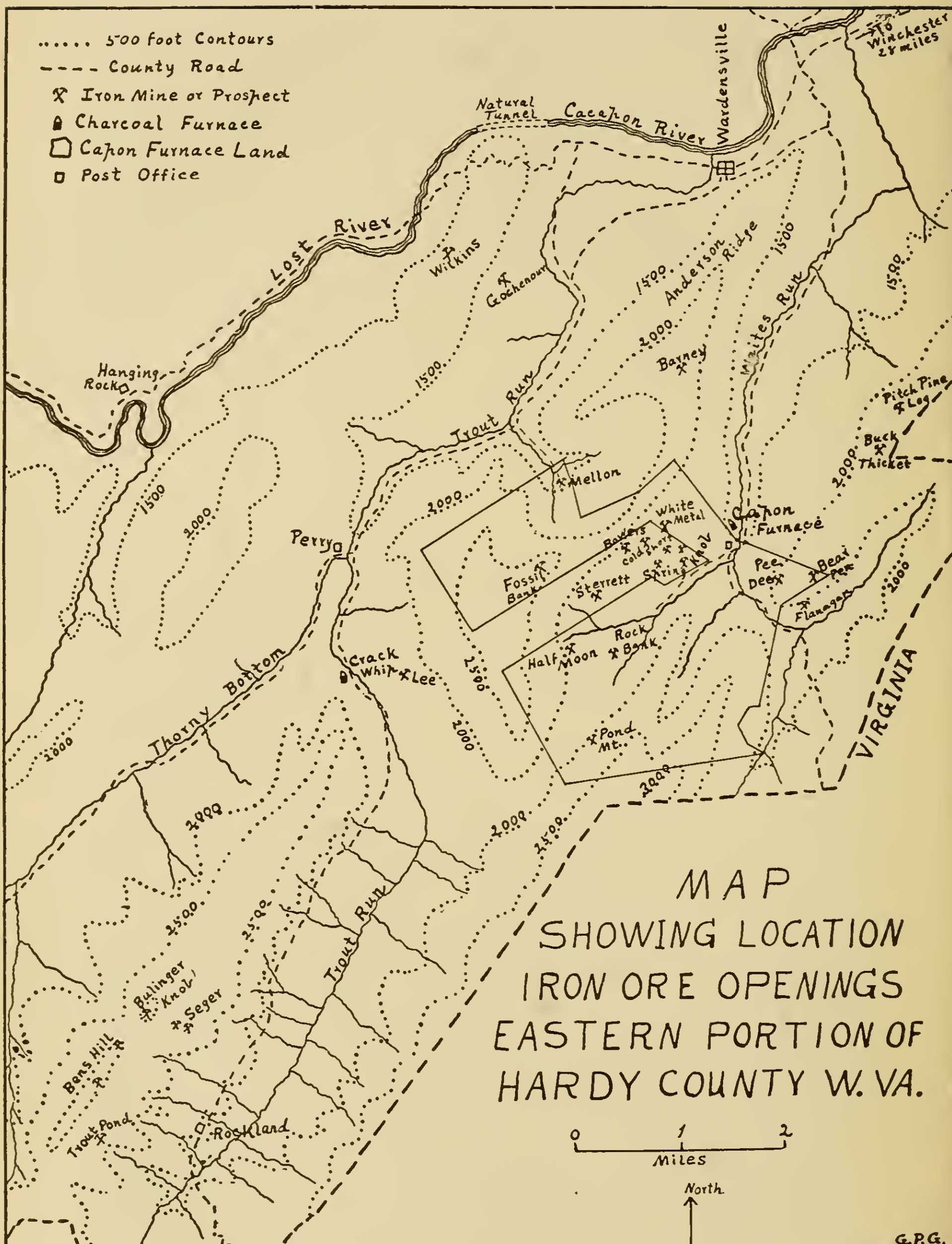


Figure 19.—Map showing the Location of Iron Ore Mines in North-eastern Hardy County.

"CAPON IRON WORKS AREA NEAR WARDENSVILLE.

"Three and a half miles due south of Wardensville is the old Capon Furnace owned by the Keller estate which includes about 4,000 acres and is surrounded by iron ore tracts owned by other parties. The county road follows up Waites Run and is 5 miles long from Wardensville.

"Capon Furnace was one of the most successful charcoal furnaces in the State and was worked almost continuously for 48 years from 1832 to 1880. (See Plate LXXIV). During this time many mines and prospects were opened, but most of them had fallen shut, but in the the past year, a number of these were reopened and new prospects excavated, so that conditions are more favorable for the ore study in this area than any other section north of Greenbrier County.

"Pee Dee Mine.—This mine was formerly used to supply ore to the Capon Furnace. but was not used during the later history of the work. It is located one mile southeast of the furnace on the western slope of North Mountain and 430 feet above the furnace level.

"The ore was mined in an open cut 125 feet long running north 30° east, also by a shaft which was sunk 43 feet deep with ore to within 8 or 10 feet of the top, and the bottom of the shaft was still in good ore according to the testimony of reliable men who worked in the mine. Later a cut 140 feet long was made at right angles (S. 38° E.) to the 125-foot trench and struck ore one-fourth of the distance. Over the ore body is a mass of buff shales exposed with a thickness of 20 feet in the trench. Above the shales is a ledge of hard white sandstone, probably the Medina, which has an exposed thickness of 25 feet. This rock dips into the mountains S. 40° E. at an angle of 28 degrees. The shales dip in the same direction 40 degrees, and the ore with an angle of 40° to 50°.

"Ten feet below the ore is a brown sandstone 15 or 20 feet thick as exposed. and breaking into courses 6 or 8 inches thick. An ore body is found below this sandstone or 36 feet below the upper ore, and was opened by a number of pits in buff shales. but these are now closed.

"The Pee Dee ore is deep brown in color, more or less honeycomb in structure and the holes filled with yellow ochre. In the shaft the ore is more solid with a bluish-brown cast, with some blocks deep brown to almost black and more or less porous. The lower bed of ore is a deep brown color more or less mottled with bluish-black areas. It contains wavy lines with black coating and breaks shaly. White clay is associated with both ore bodies. The surface ores to a depth of one or two feet show the effects of weathering and are light yellow-brown color, shaly, and lighter in weight than the main body of ore.

"The upper trench followed nearly the trend of the ore, while the lower trench at right angles cut across the bed. The openings made show the width to be at least 20 feet and an exposed length of 125 feet, but both ends of this trench were still in the ore body. The composition of the Pee Dee ore is shown in the following analyses, the first made by Ricketts and Banks,[2] and the second in the Survey

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[2]The analyses of ores by Ricketts and Banks and by Mr. Glaser used in this chapter, as well as many notes included in the discussion of the ores in eastern part of Hardy County, are taken from the writer's special report on these properties for Mr. Nathan Landauer, of Baltimore, and used with his permission.

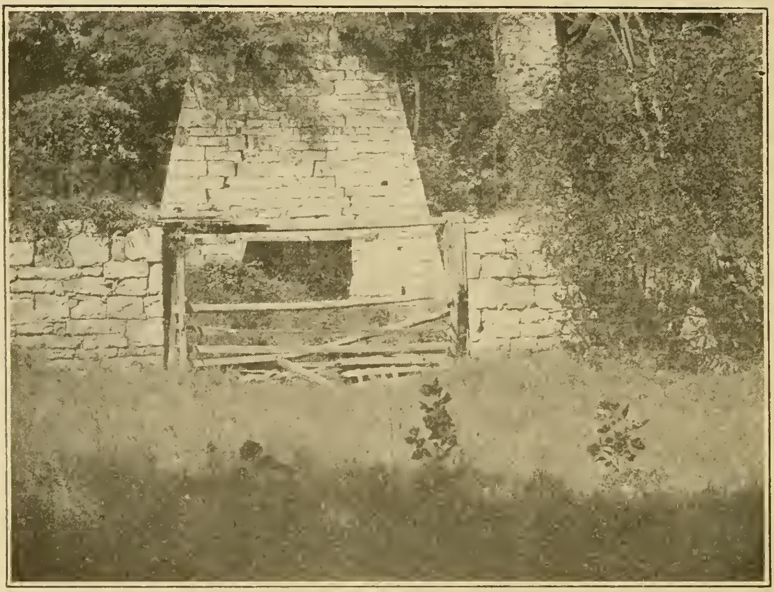

PLATE LXXIV.—Capon Furnace Stack near Wardensville, Hardy County.

laboratory; and the third analysis also made by the Survey shows the composition of the lower ore body:

	Ricketts and Banks. Per cent.	Survey. Per cent.	Lower Ore Body. Per cent.
"**Metallic iron**	**48.32**	**47.40**	**47.94**
Moisture	....	0.30	0.46
Loss on ignition	....	10.40	10.80
Silica	17.59	27.02	16.82
Iron oxide	....	68.00	68.48
Manganese dioxide	0.06	0.66	0.02
Sulphur	0.37	0.008	0.02
Lime oxide	....	0.10	0.24
Phosphorus	1.138	0.28	0.22
Titanium oxide	....	0.11	0.21

"These ores have generally been regarded as Oriskany ores similar to those mined in southern part of Virginia, but as described above they are found with the hard quartzose sandstone, the Medina, and in the shales on the mountain slope below this rock and above the brown sandstone. At the foot of the mountain and to southwest is a mass of bluish-gray limestone without fossils, probably the Shenandoah limestone.* On the top of the mountain is the Clinton formation with red hematite, thin yellow or buff sandstones filled with Clinton fossils. The fossils were kindly examined by Mr. R. S. Bassler of the U. S. National Museum, who states that Beyrichia lata is the most characteristic fossil, and that the formation is Clinton (Rockwood).

"The structure involves an overturned fold. The ore-bearing shales are probably Clinton with the Medina Sandstone above instead of in its proper position below. The lower bed is probably the same as the upper, with a portion of the Medina brown sandstone brought in between the two exposures.

"**Warm Spring Mine.**—About three-quarters of mile southwest of Capon Iron Works is a warm spring through which gas is constantly bubbling and which has long been held in high esteem as a medicinal spring for the cure of rheumatism and other disorders. On the ridge about one-fourth mile west of the land of Mrs. Kline, and 200 feet above the level of Capon Iron Works is an outcrop of reddish-brown ore which has been opened in a long trench against the sandstone wall. This coarse brown sandstone pebbly or conglomeratic in places trends N. 40° to 50° E. and dips 20 degrees S. 60° E.

"The ore next to this sandstone wall is broken by streaks and nodules of coarse reddish sand, but farther away appears to be free from the sand though sand particles are found in most of the ore. The ore is dark brown in color though some has a reddish-brown color and breaks shaly. This ore was tried at the furnace but was only opened to a limited extent and then abandoned, the sand streaks and particles being considered objectionable. Its composition is shown by the following Survey analysis and also by the analysis of another sample of Ricketts and Banks:

	Warm Spring Mine Ore.		
	Ricketts and Banks. Per cent.	Survey. Per cent.	Spring Knob Ore. Per cent.
"**Metallic iron**	**52.99**	**55.55**	**40.54**
Moisture	....	0.30	0.29
Loss on ignition	....	11.96	10.21
Silica	10.10	5.59	19.66
Iron oxide	....	79.36	57.92
Lime oxide	....	0.20	0.25
Manganese dioxide	0.14	0.30	0.30
Sulphur	0.08	0.01	0.01
Phosphorus	0.987	1.46	1.86
Titanium oxide	....	0.07	0.25

*See foot-note on page 382 regarding absence of Shenandoah Limestone outcrops in Hardy County.—R. C. T.

"The ore in its relation to the brown sandstone occupies a similar position in the Pee Dee mine.

"**Spring Knob Mines.**—On the northwestern side of the hill locally known as Spring Knob on the Kline land, and 60 feet lower than the Warm Spring mine, the brown hematite ore was opened in a trench eight feet long across the ore bed which trends N. 30° E. The bed dips to the southwest with a heavy wall of brown sandstone outcropping above forming a sharp ridge, and forming the foot-wall of the ore. The ore body has been worked with a length of about 300 feet. The openings are nearly on the N. 30° to 40° E. line from the Cold Short mine, and they are located at the big bend of the tramroad from the Half Moon mine to the furnace.

"The ore is close grained, light brown color with small openings along parallel lines giving much of the ore a shaly appearance. Its composition is shown by the above Survey analysis.

"**Manganese Prospect.**—In the road which follows the creek at the foot of Spring Knob and about 150 feet above the level of the furnace, is a heavy deposit of yellow clay in which are veins of dark brown to black ore which is soft and brittle, trending in a direction N. 40° E. The outcrop can be followed nearly 100 feet and then passes under cover. This outcrop is about 200 or 300 yards below the forks of this small Half Moon Run.

"It has been regarded from the days of the active furnace work as a most promising prospect of manganese and is always considered as one of the important resources of the area, but analysis shows it to be without trace of manganese. It apparently represents the clay with infiltrated iron and organic matter and is of no economic importance as shown by the following Survey analysis:

	Per cent.
"**Metallic iron**	**19.98**
Moisture	0.60
Loss on ignition	9.34
Silica	44.12
Iron oxide	28.40
Lime oxide	0.20
Manganese dioxide	None
Sulphur	0.02
Phosphorus	0.11
Titanium oxide	0.43

"North of the Half Moon Run with the so-called manganese outcrop and 230 feet higher is an outcrop of red to reddish-brown hematite on one of the terraces of Spring Knob. The bed follows a N. 40° E. course and has been opened across the inclined ore bed a distance of 30 feet by trenches and an old shaft. The ore is found in buff or yellow shale and is more or less laminated with bluish-black coating on these parallel planes. The east wall is a heavy gray and brown sandstone with trend N. 40° E. and dip of 36 degrees in direction N. 60° E. and the ore is opened close to this wall.

"200 feet west of this wall is an opening in buff to grayish-brown shales with blocks of reddish-brown ore associated with the clay. Fifty feet farther west the same ore is found in an opening in buff to brown shales. The shales in this opening dip 38° N. 50° to 60° W., and 30 to 40 feet farther west is a wall of sandstone similar to the east wall with a dip N. 50° W. The two ledges of sandstone represent the two slopes of an anticline with the crest removed by erosion exposing the anticlinal ore bed below in the Clinton shales. The 300-foot space between these sandstone walls is covered with large and small blocks of ore, and all the openings found the ore. The thickness of the ore can not be observed in any of the shallow prospects.

"**Henry Bowers Shaft.**—To the southwest of the last exposure, and above the burnt house near forks of Half Moon Run, a shaft was sunk to the ore by Henry Bowers. This shaft is said to be 60 feet deep and has been abandoned 50 years, but it was so strongly timbered that is stands to-day in good condition though half full of water. The ore as seen on the dump is compact and of light reddish-brown color with flakes of blue-black mineral through it, and the fracture shows a smooth glistening surface. Ore blocks of similar character are found along the mountain side following N. 40° E. direction. Its composition is shown by the Survey analysis given below.

"At the southwest end of Spring Knob an old cut was made which exposes a cliffi of Clinton ore 14 feet high, 10 feet wide, and 60 to 70 feet long. Its direction is N. 50° E. with a dip of 58 degrees S. 40° or 50° E. The foot-wall is a coarse brown sandstone and the ore seams run into it, forming near the wall a mixture of ore and sandstone. In the photograph (Plate LXXVI) the sandstone wall is shown with ore near man's head. The ore is red in color with small black velvet patches, also bluish-black spots. Some of the ore is finely granular almost oolitic, looking like the typical Clinton fossil red hematite of Grant County. It breaks with shaly fracture and glistening surface. It is compact and has the following chemical composition:

	Bowers Shaft. Per cent.	End Spring Knob. Per cent.	Sterrett Bank, Survey. Per cent.	Ricketts and Banks. Per cent.
"**Metallic iron**	**30.24**	**42.05**	**38.65**	**48.07**
Moisture	0.55	0.56	0.24	....
Loss on ignition	8.34	7.68	10.38	....
Silica	32.75	22.69	21.26	11.66
Iron oxide	43.20	60.08	55.36	68.67
Lime oxide	0.08	0.32	0.22	....
Manganese dioxide	0.09	None	2.19	0.40
Sulphur	0.01	0.045	0.01	0.14
Phosphorus	0.37	0.30	0.56	0.235
Titanium oxide	0.36	0.43	0.29	....

"**Sterrett Mine.**—This mine was used in the earlier days of the Capon furnace as a source of its ore. It is located on the Kline land northwest of Spring Knob and was worked by shafts, tunnels, and open cuts, which have long ago caved in. The old tunnels ran 800 feet into this ore along the bed, but its width can not now be determined.

"The ore is a deep brown color with black areas scattered through, giving a mottled appearance. It weathers to a yellowish brown and is slightly open or honeycomb in structure, and associated with buff shales and white clay. The level is 160 feet below the Half Moon mine, which lies in the direction of the trend of the strata S. 20° to 30° W. from the Sterrett mine. The composition of the ore on the dump is shown by the above Survey analysis.

"**Half Moon Mine.**—The Capon furnace in the later years of its history secured its ore supply mainly from the Half Moon Mountain, one of the spurs or ridges of North Mountain and 400 feet higher than the furnace.

"The mine was reached by a tramroad, and was worked by tunnels, open cuts, and two shafts. The elevation of the mine is about 500 feet higher than the Pee Dee, and the area covered by the old workings is 300 by 400 feet. The mine was worked first by a long entry and later by stripping in benches. The upper level is 30 feet wide and 200 feet long, the next level 30 feet lower was worked 50 feet wide and 250 feet long with a shaft at the south end said to have been 40 feet deep through almost solid ore

"The ore is associated with buff shales, white and yellow clays, and in the open cuts was found in the form of nodules, some of which were three and four feet across. In the shaft which is completely closed, the ore is claimed to have formed a solid bed. The ore body dips 40° southeast, but it is practically impossible to determine its trend on account of poor exposures which are concealed by the caving of the banks.

"This mine was visited by Mr. Guerard in 1875 when it was in operation and he gives the following description in the Centennial report by Maury and Fontaine (p. 268):

"'The ore bank shows in an open drift of a 100 yards, a remarkable deposit of ore. Having sunk 70 feet on the vein which is inclined at an angle of 40°, it still appeared to be continuous. The deposit lies between sandstone and limestone, of which there is a large supply, and the outcrop can be traced some distance along the mountain. Three smaller veins of the same ore crop out above this larger one; and some hundred yards below, a vein of brown fossiliferous hematite, the counterpart of which has been worked at Bloomery, in Hampshire, has lately been discovered. It is 2 feet thick near the outcrop but has never yet been worked.'

"The following analysis made of the ore collected by Mr. Guerard in 1875 was made by Dwight and may be compared with the Survey analyses of ore taken in 1907 from surface and from lower level:

	Guerard Report. Per cent.	Upper Level. Per cent.	Lower Level. Per cent.
"**Metallic iron**	**45.00**	**49.17**	**42.22**
Moisture	6.695	0.04	0.24
Loss on ignition	0.295	10.11	9.13
Silica	11.771	17.70	22.16
Iron oxide	64.287	70.24	60.32
Lime oxide	2.657	0.12	0.66
Manganese dioxide	7.680	0.03	None
Sulphur	0.472	0.02	0.05
Phosphorus	0.483	0.20	0.20
Titanium oxide	....	0.29	0.22

"A sample of pig iron made from the Half Moon ore was analyzed in the Survey laboratory and contained:

	Per cent.
"**Metallic iron**	**93.58**
Silica	1.05
Phosphorus	0.49

"The ore in its upper portion is light brown in color with cavities filled with clay and ochre and has shaly fracture, but in the boulders from the lower level and from the shaft, it appears to be a deep brown solid ore with thin plates of bluish-black color possibly manganese.

"**End Half Moon Mountain.**—At the end of the Half Moon Mountain nearest the furnace above the old corduroy road, there is a good exposure of brown hematite ore, dark brown to almost black in color, with cavities containing minute pipes of ore. It is 90 feet above the road level, and above the ore to west is a wall of white sandstone, trending N. 60° E. and dipping 32°, N. 50° E. This ore was opened many years ago in trenches and pits along the dip of the bed which lies in a hard yellow shale and in line with the trend N. 60° E. Below is an outcrop of brown sandstone. The composition of this ore is shown by the following Survey analysis:

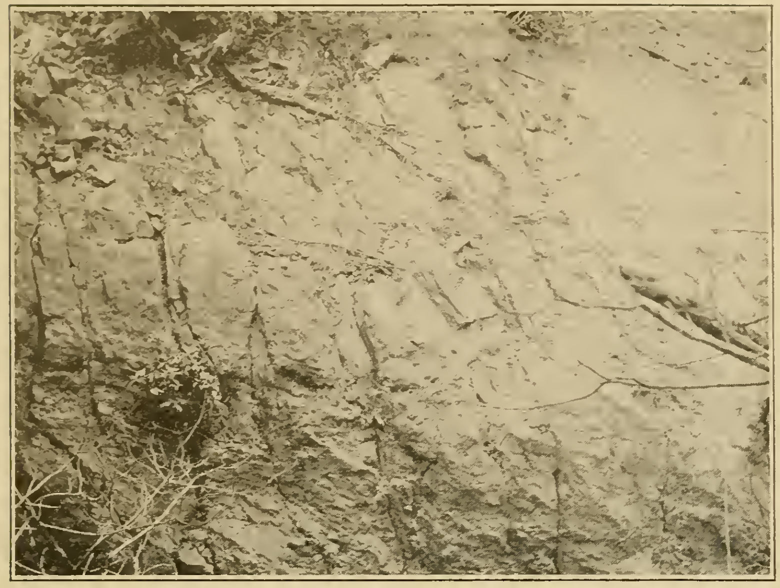

PLATE LXXV.—Foot-Wall of Ore Body at the Cold Short Mine, Capon Furnace Tract, Hardy County.

PLATE LXXVI.—Foot-Wall of Ore Body at Spring Knob Mine, Capon Furnace Tract, Hardy County.

	End Half Moon Mountain. Per cent.	Cold Short. Per cent.	White Metal. Per cent.
"**Metallic iron**	**54.58**	**38.08**	**24.31**
Moisture	0.90	0.54	0.72
Loss on ignition	13.09	11.67	9.00
Silica	3.03	23.84	35.42
Iron oxide	77.97	54.40	36.16
Lime oxide	0.25	0.44	0.46
Manganese dioxide	0.017	0.06	1.17
Sulphur	0.01	0.12	0.01
Phosphorus	1.10	0.71	0.28
Titanium oxide	0.07	0.36	0.43

"**Cold Short Mine.**—The Cold Short Mine is located on one of the lower terraces of Spring Knob, one and a half miles west of Capon Furnace, and consists of several pits and trenches which have exposed a light brown ore, with a prismatic fracture (see Plate LXXV). On weathering it tends to crumble to small prisms. This ore was claimed by the furnace men to yield a brittle iron and so was designated as cold-short, and only used in small quantity in mixture with other ores. Its composition is shown in the above Survey analysis.

"The Cold Short ore has also been opened by pits and trenches up the mountain over a vertical distance of 45 feet, and follows a direction N. 40° E. 180 feet higher in the Cold Short flat or terrace with three ore trenches following the same direction N. 40° E. and with ore similar to the lower openings, which would indicate a depth of ore of at least 180 feet at this place.

"**White Metal Mine.**—25 feet above the Flat is an old opening locally known as the White Metal Mine, where a face of ore 22 to 24 feet high is exposed, nearly 40 feet wide, and 540 feet above the furnace. Its trend is different from the main Cold Short bed, running N. 50° to 80° E.

"The ore has been followed in trenches and pits for several hundred yards east. The south wall of the ore is a hard white sandstone, dipping 46 degrees to southeast, while the main ridge near the Cold Short openings is composed of a smaller sandstone trending N. 40° E., thus forming a forked ridge at this place, and the ore bed apparently forks in same way or at least bends in direction. The White Metal ore was used for some time at the furnace in mixture with other ores. Its composition is given in the above Survey analysis.

"**Mellon Shaft.**—About one mile and a half west of the White Metal on a lower terrace, 400 feet below the level of the Cold Short flat is the Mellon shaft, 30 feet deep which was closed by caving of large boulders in 1854 so no measurements are possible at the present time.

"'The ore from this shaft was claimed by the old furnace men to be the best ore ever used at the furnace. An attempt was made to secure an average sample from the old dumps but with the length of time that has elapsed since the shaft was worked, this sample is of doubtful value in showing the real character of the ore. It has the following composition in the sample taken:

	Per cent.
"Metallic iron	47.26
Moisture	0.42
Loss on ignition	14.13
Silica	8.51
Iron oxide	67.52
Lime oxide	0.54
Manganese dioxide	3.75
Sulphur	0.002
Phosphorus	0.41
Titanium oxide	0.07

"The ore was also opened in a trench with an exposure of calcareous shales trending N. 40° E. and dipping 28 degrees S. 30° E. The east wall is a brown sandstone trending N. 40° to 50° E. To the west is sandstone and limestone forming high cliffs in the ravine near Trout Run. The ore corresponds in position to the ores on the furnace tract below the brown sandstone in the Silurian rocks.

"The iron ore on the dump has a bluish color with some pieces light brown and contains considerable dirt in the open cavities. The surface of a number of the blocks has a pitted or botryoidal surface, as though formed in bubbles, an appearance which by many people is taken as evidence of great heat or fire action involved in the formation of the ore, but is it due to water action.

"**Fossil Bank**—Not far distant from this shaft and at nearly the same level in side of creek bank, is located the so-called Fossil Bank. At this place a reddish-brown ore is found in thin seams up to 4 inches thick interlaminated in light colored shales. A tunnel was driven back 10 to 12 feet on this ore but showed nothing of value. Clinton fossils were found in the ore stringers and shales.

"**Pond Mountain.**—A large vein of ore is found on Pond Mountain on one of the ridges of the North Mountain range, four miles southwest of the furnace, and 690 feet above the valley. Its outcrop was followed nearly 200 feet up the mountain, but its width could only be traced 8 feet, and then covered by rock debris.

"The ore is dark brown to black in color, solid and of good weight. Its composition is shown by the following analysis by Mr. Glaser:

	Per cent.
"Metallic iron	45.28
Iron oxide	64.68
Silica	3.64
Sulphur	0.084
Phosphorus	0.173
Manganese	10.770

"**Rock Bank.**—This old mine is interesting in its well-defined sandstone walls, giving the ore body a typical vein appearance. It is located on the side of Pond Mountain about two and a half miles south of Capon Furnace, 450 feet above the valley at the foot of the mountain and 580 feet above the furnace level.

"The ore is enclosed by white compact sandstone walls which stand almost vertical and trend N. 40° E. The ore body is 2½ to 4 feet wide, and was worked in an open trench to a depth of 6 or 8 feet, and with a length of 200 feet. The ore is dark brown to nearly black in color, compact and hard. Some of it has a botryoidal surface, and in other places it is almost steel gray in color with few open spaces and these when present are free from dirt.

"On the mountain 55 feet higher a cross trench was made which exposed a red hematite ore instead of the dark brown hematite in sand and shales. The dark brown hematite ore is found in loose blocks along the mountain side to the east of the Rock Bank, and is found next to the sandstone above the Jack Thorpe coaling. The Rock Bank ore has the following composition:

	Rock Bank.		Flanagan Road.	
	Survey.	Ricketts and Banks.	Manganese Ore	Brown Ore.
	Per cent.	Per cent.	Per cent.	Per cent.
"**Metallic iron**	**58.66**	**53.43**	**10.38**	**39.20**
Moisture	0.80	.....	0.78	0.30
Loss on ignition	10.17	.....	6.96	9.65
Silica	3.51	8.80	51.14	22.39
Iron oxide	83.80	.....	14.68	56.00
Lime oxide	0.47	.....	0.35	0.25
Manganese dioxide	Trace	0.10	6.25	2.53
Sulphur	0.016	012	0.0096	0.023
Phosphorus	0.91	0.813	0.31	0.49
Titanium oxide	0.01	.....	0.36	0.29

"**Flanagan Road Prospect.**—At the southwest end of the ridge of North Mountain above the Waites Run gap, one and a half miles south of Capon Furnace, an outcrop of brown ore is found which breaks shaly and is light in weight. The ore is 290 feet above the creek level and 500 feet above the furnace level.

"Eighty feet higher a vein of brown hematite of better grade has been opened by a trench dug in a northeast direction. This ore was traced 72 feet higher and then concealed by a mass of large white sandstone boulders. The ore is found in buff shales and on the slope below is a heavy outcrop of the brown sandstone. The sandstone wall runs N. 40° E. and dips 50 degrees in a direction S. 50° E., the ore body coming between the upper white sandstone and the lower brown sandstone similar to the Pee Dee mine.

"'This ore body can be traced by boulders for a distance of 6 or 8 miles southwest. It is probably 500 feet lower than the red ore on top of the mountain. Sixty feet below the brown hematite ore is a mass of clay and shale ore streaks and nodules of a soft black mineral supposed to be manganese. It is a small watercourse below springs and the material appears to be a deposit from this water in the clay. Its composition and also that of the brown ore are shown in the above Survey analyses.

"**Bear Pen Prospect.**—Near the old bear pen on the Keller Capon Furnace lands at the end of the ridge of North Mountain above the last described prospect several trenches have been made in a red hematite ore which is close grained, shaly in character and breaks in long prisms with smooth glistening surfaces.

"The ore is found in white and blue shaly clays. The foot-wall is a brown sandstone trending N. 50° to 60° E. and dipping 44 degrees S. 40° E. and the ore comes in contact with the sandstone. Above the ore is a heavy ledge of very hard white sandstone which is exposed 27 feet higher than the highest ore opening. The trenches are opened 6 to 10 feet deep and are 8 to 10 feet long and while not connected are opened across the direction of the bed for a distance of 150 feet. This width which is probably greater than opened so far, is due to a folding of the bed in a syncline thus in reality representing the extent of the bed in width and not in depth. None of the holes is deep enough to show the thickness of the vein, being opened only a few inches in the ore.

"These openings are almost due south of Capon Furnace about 2½ miles. They are 640 feet above the Pee Dee mine and 1,070 feet above the Capon Furnace. No fossils were found at this place but the character of the ore, its association and level show it to be the same as at the Buck Thicket, or the Clinton ore. Its chemical composition and that of the Buck Thicket ore are shown by the following Survey analyses:

	Bear Pen. Per cent.	Buck Thicket. Per cent.	John Frye Land. Per cent.
"**Metallic iron**	**42.00**	**24.47**	**45.25**
Moisture	0.20	0.80	0.28
Loss on ignition	7.67	5.93	12.89
Silica	28.60	39.34	14.55
Iron oxide	60.00	35.96	64.64
Lime oxide	0.25	0.20	0.72
Manganese dioxide	0.41	0.13	0.72
Sulphur	0.02	0.01	0.006
Phosphorus	0.30	0.03	1.04
Titanium oxide	0.29	0.50	0.18

"The John Frye land is on the lower slope of the mountain below the Bear Pen and Buck Thicket openings, and the ore is found in large blocks but not in place.

"**Buck Thicket Prospect.**—The Buck Thicket Prospect openings are located on the same North Mountain one and a half miles northeast of the Bear Pen prospect, on the Covert land. It is 1,200 feet above Waites Run. The ore is a red hematite shaly in structure, imbedded in yellow and red shaly clays. By barometer the level of the ore is 15 feet lower than the Bear Pen ore, and the white sandstone outcrops above the ore which dips into the mountain S. 40° E. at low angle. In the highest opening the ore bed was found 10 feet below the surface and at the lowest, it was 18 feet. A section of the last opening shows:

	Feet.	Inches.
"Clay shales	6	8
Red hematite	0	6
White clay	3	..
Red ore	0	10
Clay	2	..
Red ore	0	10
Brown sandstone with fossils	0	8
Brown clay	0	10
Red ore	2	6
Clay	..	..

"The ore bed trends N. 40° E., and the brown sandstone near the ore and some of the ore contain numerous fossils, Orthis, trilobites, etc., of Clinton types so that the ore and shales are Clinton. A similar outcrop is found one mile north in the Pitch Pine Log prospect trenches. This ore has therefore been followed for 2½ miles and probably extends to north and south of these prospects, continued to the southwest on the ridge to Waites Run gap also on the ridge to south of this gap.

"**Anderson Ridge Mine.**—On the land of William Barney on Anderson Ridge, one and a half miles north of Capon Furnace and to the west of Waites Run is an old mine which furnished ore for the furnace. The ore was worked in a deep and wide open cut now caved in to a large extent.

"The ore varies from a deep brown hematite to masses of red hematite with glistening surface, and is more or less marked by black streaks and areas. Some of the ore is porous along parallel black planes. The cut was worked 35 feet in width and one shaft reached depth 30 feet. The west wall of the ore is a light brown sandstone trending N. 50° E. and nearly vertical and a wall of sandstone outcrops 75 feet east of the mine. The level of the ore is 400 feet above the valley. The composition of the ore is shown by the following Survey analysis:

	Anderson Ridge. Per cent.	Lee Tract. Per cent.
"**Metallic iron**	**34.16**	**43.96**
Moisture	0.70	0.37
Loss on ignition	9.15	10.00
Silica	27.20	15.40
Iron oxide	48.80	62.80
Lime oxide	0.30	0.17
Manganese dioxide	0.04	0.79
Sulphur	0.01	0.04
Phosphorus	1.00	0.77
Titanium oxide	0.25	0.14

"TROUT RUN AND THORNY BOTTOM AREAS.

"Trout Run empties into the Capacon River at west edge of town of Wardensville, and at a number of places along this run the loose boulders of brown hematite show the presence of an ore body. These are seen on the Barney and Barney land not far from the county road two miles southwest but no openings have been made. Eight miles southwest by road is Perry post-office where the Trout Run Valley forks, the west branch being known as Thorny Bottom, and on both streams to the south as well as to the north on Trout Run are a number of ore outcrops and a number of old prospects and mines.

"**Rudy Prospect.**—One mile north of Perry and to the east of the road on the Tucker Rudy land, are large numbers of ore blocks of brown hematite, with more or less honeycomb structure, found at the foot and on the lower slopes of the hill. This ridge is composed of heavy sandstone with trend N. 40° E. while below it is a mass of buff shales, or nearly black shales in unweathered samples.

"An attempt was made to locate the ore bed in place, but the trenches were only excavated to a depth of 3 to 5 feet and not deep enough to reach below the wash and slip of the hill. The character of the loose blocks indicates the presence of a bed of good ore somewhere near this sandstone.

"**Crack Whip Furnace.**—One mile and a half up Trout Run south of Perry the stack of the Crack Whip furnace is still standing in good condition, though it has been abandoned 40 or 50 years. A number of mines were opened through the area within a radius of 5 to 6 miles to supply ore though the main supply came from the Trout Pond region in Thorny Bottom.

"**Lee Tract.**—On the big Lee Survey of some 20,000 acres a number of openings have been made in the brown and red hematites, but only a few of these were visited. About one-half mile across the ridge to the northeast of the Crack Whip furnace is the so-called 22-foot vein of brown hematite which was used for a short time to furnish a portion of the ore for this furnace.

"When this place was opened a few feet in depth, it showed a mass of large ore boulders of good weight and quality with a width of 22½ feet by actual measurement and followed a course N. 30° E. with a heavy sandstone wall 200 to 300 feet west of the opening. This is exposed 10 to 12 feet high, dipping to the east.

"During the past year a force of men was set to work to open this deposit and it was found to be a mass of large boulders imbedded in buff shales and ten feet lower apparently gave way to shales. It is a boulder deposit and it is very doubtful whether any deeper work will show more of the ore. The real position of the ore is probably nearer the west sandstone wall, and from this have rolled boulders now seen in this opening.

"The high character of this ore and its compact structure with the absence of dirt give promise of a valuable deposit along this little stream valley. On the eastern side of the ridge, the ore was mined on a small scale according to statements of local people. The Lee boulder ore is 54 feet above the road and stream at foot of the ridge, and 230 feet above the level of the furnace. Its composition is shown by the above analysis.

"**Bulinger Knob.**—Up Thorny Bottom branch of Trout Run three miles southwest of Perry is a narrow gap through the foot ridge of the main mountain divide (Devil Hole Mountain) between the two stream valleys. The ridge to north of this gap is known as Bulinger Knob, and to the south, as Bens Hill.

Bulinger Knob rises 235 feet above the valley, and on its south point a brown hematite ore is exposed on the surface between two sandstones. To the west of the ore is a dark brown, coarse grained sandstone trending N. 40° E. and dipping 68 degrees N. 60° W. At the east of the ore is a light brown to white sandstone which dips 30°, S. 50° E.

"The ore is found in white and yellow clay and is 10 feet wide and was followed to a depth of 27 feet where is was covered by surface debris. At the foot of the mountain the valley floor is a slaty blue limestone. The ore is light chocolate brown in color with parallel wavy lines more or less open. Black areas come in through the ore which is compact and rather hard. Its chemical composition and that of the Bens Hill ore are shown by the following Survey analyses:

	Bulinger Knob Per cent.	Bens Hill Per cent.	Bens Hill Fossil Bank Per cent.
"**Metallic iron**	**42.89**	**38.96**	**42.00**
Moisture	0.38	0.45	0.41
Loss on ignition	10.54	8.73	6.78
Silica	21.03	27.52	25.24
Iron oxide	0.14	0.15	0.26
Manganese dioxide	None	0.04	0.017
Sulphur	0.03	0.012	0.09
Phosphorus	0.48	0.98	0.47
Titanium oxide	0.21	0.14	0.21

"**Bens Hill Prospect.**—To the south of Bulinger Knob across the little valley is Bens Hill which rises 280 to 300 feet above the valley to the ore horizon. The ore body trends N. 40° E. and dips 40 degrees S. 50° E. The foot-wall is a brown sandstone with dip S. 60° E. The ore near the sandstone wall contains considerable sand, but farther away is a shaly reddish brown ore, with numerous fibrous layers of a variety of limonite ore known as Goethite. The surface ore is in form of flat plates of red hematite and below this layer breaks prismatic. It has been opened by three trenches which give an exposure of one-half mile long and 10 to 20 feet wide.

"**Bens Hill Fossil Bank.**—One mile S. 30° W. of the last mine on this same ridge is an outcrop of red hematite locally known as the fossil bank though no fossils were found in the ore or associated rocks. The level of this outcrop is 420 feet above the limestone valley at the east foot of the ridge, and 665 feet above the valley at north end of ridge which would make this prospect 365 feet above the brown ore at north end of ridge.

"The ore has been opened in a trench across the bed 8 feet and shows a bright red shaly hematite with black glistening areas, and breaks with smooth glistening surface. Some layers of brown hematite are found one of which was 10 inches wide at the top but it apparently grades into the red ore.

"To the west of the ore body is a ledge of brown sandstone trending N. 50° E. Some red ore is found adhering to this wall. The whole ridge in this place shows small fragments of the red ore scattered over the surface. This sandstone is in places a conglomerate with small white pebbles. The east wall of the ore is a brown sandstone dipping N. 50° W. at an angle of 54°. The ore appears to be a Clinton hematite with the Medina Sandstone foot-wall. Its composition is shown by the above analysis.

"**Seger Prospects.**—The Seger prospect mines were opened on the west slope of Devil Hole Mountain almost due east of the Bulinger Knob and Bens Hill openings. The lower opening is 360 feet above the valley and is in form of trench, 8 to 10 feet wide, also two pits 25 feet apart east and west and worked out for a distance of 75 feet west. The ore was used for a time at the Crack Whip Furnace located northeast across the mountain, but was regarded as a cold-short ore.

"The ore is in boulders in yellow and white clay following a direction N. 70° W. The sandstone to the north runs N. 60° W. The ore is reddish-brown in color and breaks prismatic, and contains numerous glistening black areas. Its composition and that of the upper Seger opening are shown by the following Survey analyses:

	Upper Seger Mine. Per cent.	Lower Seger Mine. Per cent.	Five Mile. Per cent.
"**Metallic iron**	**41.05**	**44.13**	**34.72**
Moisture	0.50	0.35	0.22
Loss on ignition	11.02	9.65	7.73
Silica	15.18	14.60	34.74
Iron oxide	58.64	63.04	49.60
Lime oxide	0.20	0.12	0.58
Manganese dioxide	2.12	1.66	Trace
Sulphur	0.02	0.008	0.01
Phosphorus	1.22	0.54	0.14
Titanium oxide	0.29	0.21	0.21

"'The upper Seger opening is 270 feet above the lower, or 630 feet above the valley, and the ore is exposed in a trench and pit in blue and white clay. It is light brown in color somewhat shaly, but tends to break prismatic, with the surface fibrous goethite layers frequently present and also shining black areas.

"The bed follows a direction N. 60° E. and can be traced for considerable distance along the mountain and possibly extends its entire length. The west wall of the ore body is a gray to bluish-gray sandstone which dips 34° to 36° in direction S. 50° E. The ore comes in contact with this sandstone and stringers of ore are found in the wall rock. The ore apparently gives way at east to a sandy shaly rock, while the hill or ridge above is sandstone. The width of ore is about 20 feet.

"**Five Mile Bank.**—This old mine in the Trout Pond area is located about two and a half miles southwest of the Seger openings, and received its name on account of its supposed distance of five miles from the the Crack Whip furnace, though the actual distance is about eight miles. Most of the ore used at this furnace is said to have come from this mine, and the ore was held in high favor.

"The ore has a deep brown color with black areas through it and weathers on outside to a yellowish brown ochre, and breaks flaky or shaly. The west wall of the ore body is an irregular broken brown sandstone, shaly on exposed surfaces and contains ore mixed through it in cracks or fissures. It trends N. 40° to 50° E. and dips 60° in a direction S. 50° E. The ore was worked in open cuts and in one shaft which is now full of water, and is associated with buff shales, and white and yellow clay. It was worked 10 to 12 feet wide and appears to consist of a surface ore containing considerable dirt, with a better grade of shaly brown hematite below. The composition of the ore is shown by the above Survey analysis.

"**Gochenour Tract.**—On the F. Gochenour land, 2½ miles southwest of Wardensville or four miles by road, and on Chestnut Ridge, the ground is covered with blocks of solid, heavy brown hematite ore. The line of these blocks runs N. 30° to 40° E., and associated with the ore are flint boulders and nodules containing numerous fossils, also blocks of blue limestone without fossils.

"Attempts were made to locate the main ore body by trenches and pits, but only boulders were found in flaky buff shales and buff clay. The ore has a dark chocolate brown color with black velvet ore patches through it, and is free from dirt. The level is 990 feet by barometer above Wardensville. Followed to the south the shale and flint nodules are found on Grassy Knob, 135 feet higher. There is a valuable ore body on this tract but its exact position has not yet been located, and the trenches are not long or deep enough to intersect it. The composition of the Gochenour ore is shown in the following analyses:

	Survey Analysis. Per cent.	Glaser Analysis. Per cent.
"**Metallic iron**	**40.10**	**45.28**
Moisture	0.43	....
Loss on ignition	10.52	....
Silica	20.58	18.19
Iron oxide	57.28	64.68
Lime oxide	0.16	....
Manganese dioxide	0.50	0.270
Sulphur	0.012	0.043
Phosphorus	0.66	0.304
Titanium oxide	0.21	....

"The fossils in the flint nodules indicate the Lower Helderberg limestone horizon, the limestone having been mostly removed by solution, the insoluble flint nodules remaining, and the ore is probably at the Oriskany horizon.

"**Finley Prospect.**—On the Barney and Landacre 2,000-acre tract near the Finley house to the southwest of the Gochenour land about one and a half miles, the brown hematite ore is found in large blocks scattered over a large area. A trench was dug in the field not far from the house, which showed the ore in large boulders probably not in place. It will require considerable work to locate the exact position, and these boulders may only represent drift. The hole was shallow and is filled with water. The line of ore boulders follows a line approximately N. 40° E. The composition of this ore is given below.

"**Baker Mountain.**—To the north and northeast of Wardensville is Baker Mountain which rises to a height of 200 feet. There was at one time an old furnace located near its base, which used for a time the brown hematite ore from the slopes of the mountain and also used ore hauled from the Capon Furnace region. It was only operated a short time and was torn down 40 to 50 years ago.

"**John W. Frye Mine.**—On the land of John W. Frye near the foot of Baker Mountain, about one mile and a half north of Wardensville the ore was opened in the days of the old furnace. The ore has a honeycomb structure, with the pores filled with clay, and contains crystals of lime. It is found in buff shales with the limestone outcropping one-half mile west and trending N. 30° E. Farther northwest in a ravine a black slate outcrops, forming the bank of the small run.

"These loose blocks of ore with more or less lime streaks are found for nearly a mile along the foot of the mountain and are reported in larger quantity up the slope. The ore has the following composition:

	Finley Tract. Survey. Per cent.	Tract. Ricketts and Banks. Per cent.	Baker Mountain Frye Tract. Per cent.
"**Metallic iron**	**49.28**	**48.18**	**40.37**
Moisture	0.13	....	0.16
Loss on ignition	10.62	....	10.97
Silica	15.64	16.40	22.44
Iron oxide	70.40	....	57.68
Lime oxide	0.25	....	0.91
Manganese dioxide	None	0.02	None
Sulphur	0.01	0.13	0.17
Phosphorus	0.48	0.43	0.32
Titanium oxide	0.07	....	0.18

"CAPON SPRINGS AND LAFOLLETSVILLE* AREA.

"The brown hematite ore can be followed along the western slope of North Mountain by loose boulders of ore from the Capon Furnace tract northeast to beyond Lafolletsville is the southeastern portion of Hampshire County, and on beyond Rock Enon Springs in Virginia, or over a total length of 35 miles from Upper Cove of Lost River Valley to Rock Enon Springs.

"**Capon Springs Area.**—Capon Springs, one of the popular mountain resorts, is located 14 miles northeast of Wardensville in Hampshire County. One mile up the mountain road to southeast of Capon Springs and on the left of the road, the ground is thickly strewn with boulders of brown hematite. The level is about 300 feet above the Springs, but no prospect work has been done and the exact location of the ore body was not found.

"The ore has a honeycomb structure and is dark brown in color and appears around the openings as a solid heavy ore of good quality. From the size and number of boulders, there is possibility of finding a good body of the ore against the eastern sandstone ridge.

"**Farmer Lands.**—Six miles north of Capon Springs by road is the store known as Lafolletsville, and to the east and northeast on the ridges and slopes, ore blocks are thickly scattered over the ground. These are seen on the lands of Richard Lafollette, also on the B. S. Farmer and Davis Farmer tracts. These lands are close to the Virginia line and the ore extends across the line.

"On the B. S. Farmer land the ore blocks follow a N. 30° to 40° E. line with sandstone wall to the east, and the ore is found over the ridge on the eastern slope on the McKeever land. The ore has a deep brown color, compact and of good weight. On the Davis Farmer land in an old orchard and in an abandoned field the ground is thickly covered with large and small ore blocks. This tract is northeast of the B. S. Farmer and Lafollette land and the ore continues on a N. 30° to 40° E. line across the Good farm and on the

*Now known as Nero.—R. C. T.

Sheets and Moorehead tracts. Farther northeast in Virginia at Rock Enon Springs, shafts were sunk many years ago striking good ore.

"There is every indication of a very extensive ore body in this portion of Hampshire County, which deserves most careful prospecting, but no openings have been made in it, and very little attention has been directed to this area in the past. The ore is a light brown with a minute pitted appearance, and numerous patches of a black velvet ore. Its composition is shown by the following Survey analysis:

	Per cent.
"**Metallic iron**	**46.85**
Moisture	0.50
Loss on ignition	9.95
Silica	15.13
Iron oxide	66.93
Lime oxide	0.26
Manganese dioxide	0.28
Sulphur	0.025
Phosphorus	0.61
Titanium oxide	0.21

"QUANTITY OF ORE IN EASTERN HARDY AND HAMPSHIRE COUNTIES.

"While more openings have been made in these iron ores of eastern Hardy County than in any other area in the State, they are more or less scattered, and not wide or deep enough to enable one to estimate quantity with any degree of accuracy, yet probable estimates can be made which are of interest in showing the great possibilities of the area.

"At one or two places the ore bodies have been followed down the mountain 180 to 200 feet and they probably extend to the floor of the valley 350 to 400 feet if not farther. 200 feet may be considered conservative for depth of ore body until actual testing by the drill is made. Widths of 15 to 30 feet have been measured.

"There is a bed of red hematite on the top of North Mountain traced 3 miles and it doubtless extends much farther.

"The ore body along the white (Medina) sandstone has been followed along the North Mountain on more or less widely separated exposures for a distance of 35 miles, but it also occurs on both slopes of the smaller ridges to the west which separate the valley of Waites Run, Trout Run, Thorny Bottom, which as followed would add 20 to 25 miles of outcrop.

"There is the second body of brown hematite below the brown sandstone traced over 8 or 10 miles of outcrop, with possibility of being more extensive. There would be for all the ore bodies a total length of outcrop not far from 70 miles. There is at present time not enough data to determine the average width of the ore over this outcrop, nor is it possible to state that the ore is continuous over this entire distance. It is in all probability cut out here and there and probably widens and narrows along the outcrop. There is another ore body at the contact of the Helderberg Limestone and Oriskany Sandstone only observed at a few places but it may prove to be an extended deposit. There are the Lost River ores probably near the Lower Silurian (Salina) limestone, whose extent is not known.

"The possible additions to the ore supply will probably compensate the error of overestimating the ores on North Mountain and adjoining ridges. If we assume this length of ore bodies to be 50 miles with average width of 15 feet and depth of 200 feet, there would be 30,000,000 cubic yards of ore, or 75,000,000 tons which would run five 500-ton furnaces a hundred years. Thorough prospect work and drilling will in all probability increase this estimate rather than lower it, and probably 100,000,000 tons would be nearer a correct estimate.

"TRANSPORTATION.

"There is not a mile of railroad* in Hardy County or eastern Hampshire County. A number of surveys have been made in past years for railroads, connecting with the Baltimore and Ohio or the Southern lines in Virginia. There are three possible routes from Wardensville, two of which have been surveyed a number of years ago.

"One of these possible routes is to the southeast connecting with the Southern Railroad near Edinburg, passing from Wardensville up Waites Run and through the low gap between Mill Creek and Paddy Mountain, and down Stony Creek to Edinburg. This line would be about 28 miles long. The elevation at Wardensville is 1,200 feet, and 2,150 feet at the highest point in the Paddy Mountain gap, or a rise of 950 feet in a distance of 12 miles or about 80 feet to the mile, or 1½ per cent. grade. The elevation at Edinburg is about 900 feet or a fall of 1,250 feet in a distance of 16 miles or nearly 80 feet to the mile. A narrow-gauge road from Edinburg to Liberty Furnace now extends up Stony Creek along this proposed route.

"A second possible route is from Wardensville to Winchester following the Cacapon Valley to one mile south of Yellow Sprnigs, there passing up the small creek valley past Lafolletsville, and through a gap to the north and past Rock Enon Springs, thence southeast through one of the gaps in the Little North Mountain to Winchester. This line would be 36 to 40 miles long and the grade would rise from 1,200 feet at Wardensville to 1,300 feet at the gap near the Frederick, Virginia, county line, and 800 feet at Winchester.

"The third possible outlet would be to the north following the Cacapon River Valley to the Potomac where the road would connect with Baltimore and Ohio and Western Maryland. This line would be 80 to 90 miles long with low grades, and could be built with little difficulty to north of Capon Bridge. Here the river flows through a narrow gorge reported to be too narrow for a road, but this gorge was followed in the course of the present study, and there is room for a road except for a distance of a few hundred yards possibly at its south end where the roadbed would have to be blasted in the side of the rock cliff.

"It is reported that north of the Forks of Cacapon, a gorge closes in with the river flowing between vertical rock cliffs, but the river might be left to the east at the Forks and the road follow some one of the smaller valleys. This portion of the road will require a careful engineering survey to determine a practical route.

"A railroad built into these counties, in addition to opening a large iron ore area would also reach an important timber belt of pine, oak, chestnut, chestnut oak with its bark, hickory, etc., covering many square miles. It would also give an impetus to farming and grazing in the fertile valleys of the Cacapon and its tributaries. After the timber is cut from many of these mountain ridges, there will be available a good limestone soil of remarkable fertility. Experiments have proved that these mountain slopes are especially well adapted to orchards and vineyards.

"With a standard-gauge road at Wardensville, it would be possible

*In 1907. The Baltimore and Ohio's South Branch (Petersburg Branch) now goes through Hardy and the Winchester and Western reaches Wardensville in northeastern Hardy County.—R. C. T.

IRON ORE ANALYSES, HARDY COUNTY
Moorefield and Lost River Regions.

Survey No.	Mine or Prospect.	Metallic Iron	Iron Oxide	Silica	Manganese Dioxide	Phosphorus	Sulphur	Lime Oxide	Moisture	Loss on Ignition	Titanium Oxide	Kind of Ore
46	Baker, Moorefield	44.46	63.52	8.30	0.035	0.48	0.019	10.35	0.50	10.75	0.07	Hematite
48	Burns Knob, Moorefield	52.70	75.28	13.81	0.04	0.26	0.007	0.22	0.14	9.71	0.01	Limonite
45	Fisher, Moorefield	53.14	75.92	10.48	0.035	0.15	0.001	0.46	0.24	10.14	0.07	"
81	Ruckman, Moorefield	31.96	45.65	34.41	....	....	....	....	....	....	....	"
34	Strausman, Lost River	39.20	56.00	35.86	0.017	0.23	0.000	0.08	0.10	11.35	0.07	"
7	Wood, Lost River	50.96	72.80	12.44	0.47	0.41	0.023	0.40	0.27	8.83	0.18	"
35	Bear Wallow, Lost River	44.69	63.84	21.63	0.04	0.39	0.02	0.16	0.29	6.66	0.21	"
	Average	45.30	....	19.56	0.091	0.27	0.01	1.67	....	....	....	

Iron Ore Analyses, Hardy County, Wardensville Region.

Survey No.	Mine or Prospect.	Metallic Iron	Iron Oxide	Silica	Manganese Dioxide	Phosphorus	Sulphur	Lime Oxide	Moisture	Loss on Ignition	Titanium Oxide	Kind of Ore
38	Pee Dee, Capon	47.40	68.00	27.02	1.66	0.28	0.008	0.10	0.30	10.40	0.11	Limonite
17	Pee Dee, lower bed	47.94	68.48	16.82	0.02	0.22	0.02	0.24	0.46	10.80	0.21	"
36	Warm Spring Mine	55.55	79.36	5.59	0.30	1.46	0.01	0.20	0.30	11.96	0.07	"
37	Warm Spring Hill	40.54	57.92	19.66	0.30	1.86	0.01	0.25	0.29	10.21	0.25	"
8	Spring Knob	42.06	60.08	22.69	0.00	0.30	0.045	0.32	0.56	7.68	0.43	"
32	Bowers shaft	30.24	43.20	32.75	0.09	0.37	0.01	0.08	0.55	8.34	0.36	"
21	Sterrett Mine	38.65	55.36	21.26	2.19	0.56	0.01	0.22	0.24	10.38	0.29	"
20	Half Moon, upper level	49.17	70.24	17.70	0.03	0.20	0.02	0.12	0.04	10.11	0.29	"
2	Half Moon, lower level	42.22	60.32	22.16	0.00	0.20	0.05	0.66	0.24	9.13	0.22	"
24	Half Moon Mountain	54.58	77.97	3.03	0.017	1.10	0.01	0.25	0.90	13.09	0.07	"
28	Cold Short Mine	38.08	54.40	23.84	0.06	0.71	0.12	0.44	0.54	11.67	0.36	"
27	White Metal Mine	24.31	36.16	35.42	1.17	0.28	0.01	0.46	0.72	9.00	0.43	"
5	Mellon Shaft	47.26	67.52	8.51	3.75	0.41	0.002	0.54	0.42	14.13	0.07	"
6	Rock Bank	58.66	83.80	3.51	trace	0.91	0.016	0.47	0.80	10.17	0.01	"
9	Flanagan Road	39.20	56.00	22.39	2.53	0.49	0.023	0.25	0.30	9.65	0.29	"
39	Bear Pen	42.00	60.00	28.60	0.41	0.30	0.02	0.25	0.20	7.67	0.29	Hematite
40	Buck Thicket	24.47	35.96	39.34	0.13	0.03	0.01	0.20	0.80	5.93	0.50	"
4	Frye land	45.25	64.64	14.55	0.72	1.04	0.006	0.72	0.28	12.89	0.18	Limonite
44	Anderson Ridge	34.16	48.80	27.20	0.04	1.00	0.01	0.30	0.70	9.15	0.25	"
43	Lee tract	43.96	62.80	15.40	0.79	0.77	0.04	0.17	0.37	10.00	0.14	"
11	Bulinger Knob	42.89	61.26	21.03	0.00	0.48	0.03	0.14	0.38	10.54	0.21	"
41	Bens Hill	38.96	55.68	27.52	0.04	0.98	0.012	0.15	0.45	8.73	0.14	"
14	Bens Hill fossil	42.00	60.00	25.24	0.017	0.47	0.09	0.26	0.41	6.78	0.21	"
42	Seger, upper	41.05	58.64	15.18	2.12	1.22	0.02	0.20	0.50	11.02	0.29	"
29	Seger, lower	44.13	63.04	14.60	1.66	0.54	0.008	0.12	0.35	9.65	0.21	"
3	Five Mile mine	34.72	49.60	34.74	trace	0.14	0.01	0.58	0.22	7.73	0.21	"
19	Gochenour	40.10	57.28	20.58	0.50	0.66	0.012	0.16	0.43	10.52	0.21	"
18	Finley	49.28	70.40	15.64	0.00	0.48	0.01	0.25	0.13	10.62	0.07	"
1	Baker Mountain	40.37	57.68	22.44	0.00	0.32	0.17	0.91	0.16	10.97	0.18	"
23	Farmer land	46.85	66.93	15.13	0.28	0.61	0.025	0.26	0.50	9.95	0.21	"
	Average	40.22	....	20.65	0.627	0.613	0.027	0.31	....	....	....	"
	County average	42.79	....	20.44	0.526	0.551	0.024	0.57	....	....	....	"

to connect the various valleys with the main line by either narrow- or standard-gauge branches, reaching the still smaller valleys with tramroads. It would be possible at minimum expense of construction to assemble these ores from the various districts above described at Wardensville. Whether this point would be the proper place for the erection of blast-furnaces or not, would be a question for discussion. The ore and limestone would be available at this place and the coke would have to be brought in so that it would probably be better to ship the ore to the main-line railroads there to meet the coke or to be transported to existing furnaces at more or less distant points. If the railroad was constructed along the north route, the ore could be shipped to the Potomac, and the coke brought to that place. There are advantages in both locations, and a careful study of cost of materials, freight rates, labor conditions, etc., would have to be made before the question could be practically answered."

Dr. J. M. Callahan in his History of West Virginia gives a short account of the Early Iron Industries of Hampshire County and Other Early Industries of the region, as follows:

"Early Iron Industries of Hampshire.

"Among the early iron industries in Hampshire was the Hampshire Furnace Company, whose plant was built and operated by Edward McCarty, on Middle Ridge, twelve miles south of Romney. The forge for the furnace was near Keyser. An extensive business was carried on by this company, as shown by the many ponderous account books of 1816-18 now in possession of the Clerk of the Courts at Romney. The Bloomery Furnaces, ruins of which are still to be seen, were built and operated by a Mr. Priestly, and were being run in 1833. Large quantities of iron were made and shipped over the Cacapon River on rafts and flatboats. S. A. Pancoast purchased these furnaces in 1846, and after his death they continued in other hands until 1875.

"Other Early Industries.

"In 1880, Robert Sherrard built at Bloomery a large stone mill and also a woolen mill. William Fox built a merchant mill in Fox's Hollow in 1818, and shipped flour by boat to Georgetown. Hammock's Mills, flour and woolen, was another very early plant. Also the Painter mill was a pioneer establishment on North River about a century ago. Colonel Fox established a Tannery in 1816 in Fox's Hollow, which was operated until the Civil War. Another tan-yard was on Dillons Run, and Samuel Gard had another extensive tannery at Capon Bridge prior to 1820. New methods came in and the leather trade in this State had to succumb to the advance of this industry and improved machinery. Distilleries were located at many points in the county.

"In the pioneer era of West Virginia following the earliest period of settlement, there were a number of iron furnaces which supplied iron for local needs. In Monongalia and Preston Counties were several iron furnaces at an early date, possibly by 1790 or earlier. One on Deckers Creek above Morgantown was working in 1798. Another, the old Cheat River furnace, several miles from Morgantown, near Ices Ferry, was standing in that year. More than a dozen furnaces were operating in the vicinity in the half century before the Civil War. Some of them were operated ten or fifteen years after the War. The manufacture of iron on Cheat, near Ices Ferry, became an important industry by 1849. Early in the nineteenth century, possibly by 1810, iron from Hampshire County was transported in boats down the Cacapon River, and thence down the Potomac to Georgetown. In Hardy County, near Wardensville and Moorefield, were other furnaces, some of which operated until after the Civil War. Near Greenland Gap in Grant County was another, the Fanny Furnace, which was well known in its day for the fine quality of cook stoves manufactured. A furnace on Brushy Fork, Barbour County, which was built in 1848, made 9,000 pounds of iron a day. It was worked for six years. In the smelting, charcoal was used as fuel, although the furnace stood on a vein of coal. The iron was hauled by mule teams 50 miles to the Monongahela River, near Fairmont, for shipment by boat to the down-river market. The blast was operated first by water-power and afterwards by an engine (Believed to have been the first in Barbour County), about 1850. It was thirty-nine feet high when built. The last furnace which was operated in West Virginia was the old Capon Furnace, six miles south of Wardensville, Hardy County, which was built in 1822 and was finally closed in 1880. It was worth about $15,000 in 1832, exclusive of real estate. In the later period of its operation the cost of hauling the iron across the mountains to the railroads was ten dollars a ton, which, added to the expense of production, made the cost of the iron at the railroad $25 a ton. During the prosperous years of the furnace, prices for the product ranged from $40 to $60 a ton. In 1855 the plant produced 220 tons of iron. The doom of the old style furnace resulted in part from the opening of the Sault Ste. Marie Canal in 1855, furnishing cheap transportation for vast quantities of cheap iron ore on Lake Superior which began to move eastward. The final decline followed Bessemer's process of making steel which drove much of the old wrought iron from the field. Competition became too severe for the costly methods necessary in mining and in reducing low-grade ores. One by one the old stacks were abandoned and the furnaces speedily went to ruins. A number of dilapidated chimneys remain, mute witness of former industry, and of small fortunes made or lost."

Recent Tests.

During the progress of field work in Hardy County, the iron ore prospects which could be found with the assistance of guides or by personal search were visited by Dr. Wm. F. Prouty and R. C. Tucker or by Paul H. Price and R. C. Tucker. Many of the old mines and prospects had fallen shut and in many cases practically all traces of former diggings were obliterated, while in a few instances it was possible to procure a sample of the ore from the material found on the old dump or trench.

The **Half Moon Mine** of the Capon Iron Company, 5 miles south of Wardensville, a description of which by Dr. Grimsley appears on a preceding page of this report, was visited by Price and Tucker and sampled (No. 4-PH, Laboratory No. 2944) by Price. This sample was analyzed by B. B. Kaplan, Chemist of the Survey, with the following results:

	Per cent.
Silica (SiO_2)	14.00
Ferric Iron (Fe_2O_3)	23.54
Manganous Oxide (MnO_2)	41.18
Loss on Ignition	15.90
Total	94.62

This ore appears to contain more manganese than iron. Another sample of ore from the **Half Moon Mine**, (No. 5-PH, Laboratory No. 2930), also analyzed by Mr. Kaplan, shows a metallic iron content of 40.6 per cent., with the other constituents as follows:

	Per cent.
Silica (SiO_2)	20.80
Ferric Iron (Fe_2O_3)	58.00
Alumina (Al_2O_3)	11.00
Phosphoric Acid (P_2O_5)	0.10
Loss on Ignition	10.00
Total	99.90

A third sample of iron ore from the **Half Moon Mine** was also collected from the loose material around the mine by Paul H. Price, (Sample No. 6-PH, Laboratory No. 2933), and analyzed by B. B. Kaplan, Chemist of the Survey. The metallic iron content was 43.00 per cent. The other results of the analysis are as follows:

	Per cent.
Silica (SiO_2)	21.00
Ferric Iron (Fe_2O_3)	61.40
Alumina (Al_2O_3)	7.21
Phosphoric Acid (P_2O_5)	0.39
Loss on Ignition	10.00
Total	100.00

A sample (No. 1-T, Laboratory No. 2946) of the Clinton Iron Ore from the **I. Sam Shaffer** farm (elevation, 2375′), with prospect above road at point where trail leads northward towards Elkhorn Rock, 1.2 miles northwest of Brake, was collected by R. C. Tucker in company with Dr. Wm. F. Prouty, and analyzed by B. B. Kaplan, Chemist of the Survey, with the following results, the metallic iron content being 49.70 per cent.:

	Per cent.
Silica (SiO_2)	16.40
Ferric Iron (Fe_2O_3)	71.00
Alumina (Al_2O_3)	5.71
Magnesia (MgO)	trace
Phosphoric Acid (P_2O_5)	0.68
Loss on Ignition	5.92
Total	99.71

A sample (No. 3-T, Laboratory No. 2921) of Clinton Iron Ore was also collected by Tucker on Elkhorn Run, about on Grant-Hardy County line, possibly in edge of Grant County, at an elevation of 1980 feet, on the 1200-acre tract of the **Hardy Iron Co.**, near the house of I. Sam Shaffer, 1½ miles southeast of Masonville. The prospect was also visited by Dr. Prouty. The analysis of the sample made by B. B. Kaplan, Chemist of the Survey, reads as follows, the metallic iron content (Fe) being 50.80 per cent.:

	Per cent.
Silica (SiO_2)	10.06
Ferric Iron (Fe_2O_3)	72.70
Alumina (Al_2O_3)	11.02
Lime (CaO)	0.45
Magnesia (MgO)	0.25
Phosphoric Acid (P_2O_5)	0.57
Loss on Ignition	4.61
Total	99.66

Another sample of Clinton Ore from the mine of the **Hardy Iron Company** on property leased from **Ketterman** was collected by Tucker (Sample No. 4-T, Laboratory No. 2922) 1.6 miles southwest of Elkhorn Rock. The sample was analyzed by B. B. Kaplan, Chemist of the Survey, and showed a metallic iron content of 42.70 per cent. The other determinations made show as follows:

	Per cent.
Silica (SiO_2)	14.05
Ferric Iron (Fe_2O_3)	61.03
Alumina (Al_2O_3)	10.44
Lime (CaO)	5.80
Phosphoric Acid (P_2O_5)	0.93
Loss on Ignition	7.60
Total	99.85

A sample of Oriskany Iron Ore, "Red Hematite", was collected by Tucker (Sample No. 5-T, Laboratory No. 2931) on the east side of Elkhorn Mountain (South Branch Mountain), about 1 mile northwest of Brake. The analysis by B. B. Kaplan, Chemist of the Survey, shows a metallic iron content of 37.30 per cent., with other results as follows:

	Per cent.
Silica (SiO_2)	29.30
Ferric Iron (Fe_2O_3)	53.15
Alumina (Al_2O_3)	11.59
Phosphoric Acid (P_2O_5)	0.76
Loss on Ignition	5.10
Total	99.90

A sample (No. 6-T, Laboratory No. 2932) was also collected by Tucker from the "Brown Hematite" (Oriskany) ore on the property of the **Elkhorn Iron Company**, one-half mile north of Burns Knob, on Elkhorn Mountain. This sample showed a metallic iron content of 52.50 per cent. From the table on a preceding page showing the summary of analyses made for Grimsley's report on the area, it will be noted that the metallic iron content of a sample he collected from the Burns Knob mine prospect was 52.70 per cent. as against 52.50 per cent. in the sample collected by Tucker. The iron oxide shows 75.28 per cent. in the Grimsley sample and 75.00 per cent. in Tucker's sample. The main difference in the two analyses appears in the amount of silica, Grimsley's sample showing 13.81 per cent. while Tucker's shows only 9.35 per cent. It should be stated, however, that Grimsley's sample was from Clinton ore from Burns Knob itself while Tucker's sample, as stated above, was from the Oriskany ore one-half mile north of Burns Knob. No recent test has been made of the Clinton ore from Burns Knob. The other determinations as reported by B. B. Kaplan, Chemist of the Survey, who analyzed the sample, are as follows:

	Per cent.
Silica (SiO_2)	9.35
Ferric Iron (Fe_2O_3)	75.00
Alumina (Al_2O_3)	6.13
Phosphoric Acid (P_2O_5)	0.23
Loss on Ignition	9.65
Total	100.36

Tucker also received a sample of iron ore from the **Cunningham** tract of the **Elkhorn Iron Company** on Elkhorn Mountain collected by M. S. Henkel, of Moorefield, West Virginia. This sample (No. 7-T, Laboratory No. 2935) was analyzed by B. B. Kaplan, Chemist of the Survey, with the following results, the metallic iron (Fe) content being 50.45 per cent.:

	Per cent.
Silica (SiO_2)	11.66
Ferric Iron (Fe_2O_3)	72.15
Alumina (Al_2O_3)	5.79
Phosphoric Acid (P_2O_5)	0.22
Loss on Ignition	10.50
Total	100.32

A sample of ore from the **Tom H. Hines** prospect in which **Charles Sherman** also has an interest was collected by Tucker (Sample No. 9-T, Laboratory No. 2937). This prospect is about 1½ miles southeast of Fabius. The ore occurs near the axis of a minor syncline to the east of the Whip Cove Syncline and is in the Catskill Series. The occurrence is a rather freakish one and appears to be a minor accumulation in the syncline mentioned. The analysis by Kaplan shows a metallic iron content of 47.40 per cent. Other determinations made show as follows:

	Per cent.
Silica (SiO_2)	24.50
Ferric Iron (Fe_2O_3)	67.80
Alumina (Al_2O_3)	6.80
Phosphoric Acid (P_2O_5)	0.02
Loss on Ignition	0.80
Total	99.92

Mr. Hines also reported that some of the same kind of ore was encountered in a well dug on the Wilson farm about a half mile southwestward from his prospect, but the Wilson family was unable to furnish any samples of the material found, Mrs. Wilson verifying Mr. Hines' statement, however, that a similar ore was found. From the quantity and quality, with such a high silica content, the ore would not appear to be a very valuable one at present for its iron content, although for specimen purposes it might have some slight present value to collectors.

The strike of the beds where the above sample was taken on the Hines farm is N. 25° E., and dip 20° west. The ore occurred in shaly, thin-bedded sandstone or sandy, micaceous shale. Some of the pieces were quartzitic. The digging was about 8 feet deep, but no one was exposed in the prospect hole. Some of the impure pieces, however, were left on the dump. The sample analyzed was one of the best pieces collected by Mr. Hines and Mr. Sherman.

While climbing South Branch Mountain along the trail at the head of Dover Hollow toward Sand Spring, Tucker picked up a small piece of iron ore at an elevation of 2800 feet, apparently in the Pocono Series or the top of the Catskill. The last reds seen on this climb were at an elevation of 2700 feet. The ore was only a few inches thick and was not found in place. It had a metallic iron content of 31.00 per cent., according to B. B. Kaplan, Chemist of the Survey, who analyzed the sample. Other tests show the following results (Sample No. 12-T, Laboratory No. 2936):

	Per cent.
Silica (SiO_2)	33.20
Ferric Iron (Fe_2O_3)	44.30
Alumina (Al_2O_3)	11.25
Phosphoric Acid (P_2O_5)	0.22
Loss on Ignition	11.50
Total	100.47

Sample No. 14-T (Laboratory No. 2949) was collected by Tucker from a piece of iron ore in the yard of **J. W. Keller**, on Mill Gap Run, 1 mile northwest of Lost River P. O. Mr. Keller reported the ore as coming from a dug well, which had an elevation of about 1640 feet near his house. The analysis by B. B. Kaplan, Chemist of the Survey, showed a metallic iron content of 48.20 per cent. Kaplan also made the following determinations:

	Per cent.
Silica (SiO_2)	20.10
Ferric Iron (Fe_2O_3)	68.85
Alumina (Al_2O_3)	5.02
Phosphoric Acid (P_2O_5)	0.23
Loss on Ignition	5.30
Total	99.50

The ore has the appearance of being Clinton, but the depth of the well reported was scarcely deep enough to reach the Clinton. Mr. Keller's house occurs near the contact of the Rondout and Bloomsburg and owing to the high silica content it may have been Bloomsburg.

Price and Tucker visited some of the old prospects in the Furnace region but as they had no guide and the region is sparsely populated they were unable to determine the ownership of the property on which Sample No. 17-T was collected by Tucker (Laboratory No. 2951) 1½ miles south of Furnace, from the Clinton Ore which had been prospected on the west side of Waites Run at an elevation of approximately 1540 feet. The dip was 45° W. with a foot or more of ore exposed in the trench. The sample was analyzed by B. B. Kaplan, Chemist of the Survey, who reported it having a metallic iron content of 48.70 per cent., and other determinations as follows:

	Per cent.
Silica (SiO_2)	9.48
Ferric Iron (Fe_2O_3)	69.60
Alumina (Al_2O_3)	6.08
Phosphoric Acid (P_2O_5)	1.42
Loss on Ignition	13.50
Total	100.08

IRON AND ITS COMPOUNDS.

Some of the remarks of Dr. G. P. Grimsley relating to "Iron and Its Compounds" contained in Chapter I of Volume IV of the Survey are worthy of repetition here in view of the wide-spread belief in Hardy County that its iron ores are of great present value. Excerpts from the Chapter mentioned are given on the following pages:

"Iron is one of the most abundant elements in the rocks of the earth's crust, ranking fourth (5.08 per cent.) in quantity according to the determinations of F. W. Clarke, of the U. S. Geological Survey.

"Limestone, sandstone, shales, clays, and the various types of igneous rocks all contain iron. All waters, salt and fresh, contain this element. Its distribution is therefore world wide and it occurs in rocks of all geological groups and subgroups.

"Iron is rarely found in the earth's rocks in a pure or native state. The only large masses of native iron known in the earth's crust are in the basalts (volcanic rocks) near Ovifak, Greenland. It also occurs in practically all meteorites where it is alloyed with nickel. While of mineralogical interest, native iron has no economic importance.

"The valuable ores of iron in the world are compounds of iron with various chemical elements forming the following varieties:

"Oxides	Magnetite (Fe_3O_4)
	Hematite (Fe_2O_3)
	Limonite ($Fe_2O_3 + nH_2O$), or brown hematite.
Carbonate	Siderite ($FeCO_3$)
Sulphide	Pyrites (FeS_2)
Sulphate	Copperas ($FeSO_4 + 7H_2O$)

"Iron is also found with a great variety of elements forming the various iron minerals, but these are not of economic importance as sources of iron.

"The important iron ores used as sources of metallic iron are the oxides and carbonate, which, when theoretically pure yield the following percentages of metallic iron (Dana, Text-Book of Mineralogy):

	Percentage of metallic iron.	Yield in pounds of metallic iron per ton of theoretically pure ore.
"Magnetite	72.4	1,448
Hematite	70.0	1,400
Limonite	59.8	1,196
Siderite	48.2	964

"The ores are never found pure in nature but are mixed with various other chemical compounds, which lower the theoretical yield of the ores, as shown in the following analysis of one of the West Virginia limonites, which, if absolutely pure, would contain 59.8 per cent. of metallic iron:

	Per cent.
Metallic iron	48.18
Silica	16.40
Manganese	0.02
Sulphur	0.13
Phosphorus	0.43

"In addition to the chemical impurities, a portion of which are shown in the above incomplete analysis, there are various foreign substances present in the ores, as clay, sand, rock fragments, which tend to further lower the yield of metallic iron per ton of ore as taken from the mine.

"The value of an iron ore depends in part upon the percentage of metallic iron, but even more on the nature and effect of the impurities present. Some of the impurities are inert, some are injurious, while others may be beneficial in the iron for certain uses. The study of the character and reactions of the foreign material in iron ores thus becomes a most important subject, and must be thoroughly understood before the real value of a given ore can be determined.

"In the earlier days of the iron industry the good and bad characters of iron ores were often known without understanding the cause. Certain ores could be worked at a profit in the old charcoal furnaces, while other ores, in the same region, were found to be of no value when tested, although by the eye little or no difference could be detected. No attempt was made to determine the causes of the different reactions, but the so-called bad ores were left in the ground, while other ores farther and farther away from the furnace were mined. Later study of such discarded deposits has revealed the presence of chemical impurities which rendered the ore unfit for use in the old style furnace, while often by modern methods of mixing and treating the ores, they have been found valuable.

"Hematite (Fe_2O_3).

"Hematite is distinguished from magnetite by its red streak and lack of magnetic properties, while magnetite leaves a black streak. At the present time it is the great source of iron......

"The bright crystalline variety of this ore is known as specular hematite, which sometimes is marked by a brilliant display of colors, as seen in the island of Elba ores now practically exhausted. The ordinarily dull ore is the red hematite and the loose earthy material is called ocher and occurring in red and yellow colors, is used for paint. A few examples of well-known hematite are given to illustrate the general character of this group of ores.

"**Clinton Iron Ores.**—In the Clinton Formation of the Upper Silurian rocks there is found in many places a red hematite horizon in the shales and limestones, well exposed in Wisconsin, Ohio, Kentucky, New York, Pennsylvania, Virginia, West Virginia, Tennessee, Georgia, Alabama. The ore is often filled with casts of shells and crinoids forming the red fossil ore, while again it is made up of rounded grains forming the red oolite ore. The Clinton ores are sometimes high in lime passing below into a limestone. The thickness of the ore in Wisconsin is 12 to 25 feet. At the type locality, Clinton, New York, there are two ore beds, an upper two-foot vein, separated by a foot of shale from a lower eight-inch bed.......

"'The Clinton ores are often designated as hard and soft, referring to differences in composition. The surface ore, more or less leached of lime, shows a higher percentage of iron and in places is somewhat loose and porous so that it has been called the **soft ore** and may vary in thickness from a few inches to several feet. Below the soft ore is the so-called **hard ore** which still retains its lime and therefore shows a lower percentage of iron. The Clinton ores are usually high in lime and also in phosphorus, the latter preventing their use for Bessemer iron. At Clinton, New York, the ore averages 44 per cent. metallic iron in furnace runs.......

"Limonite ($Fe_2O_3 + n\ H_2O$).

"**Limonite** is chemically ferric iron like hematite plus 10 to 14 per cent. of water. It is found in a variety of colors, mostly brown or yellow, and leaves a yellowish-brown streak. It is found in form of pipes, stalactites, fibrous masses, concretionary and nodular ores, and in beds or strata. Its distribution is more wide-spread than the other two types, but its percentage of metallic iron is lower, and the percentage of impurities is usually higher. It is often called brown hematite and in total production ranks next to red hematite, but only includes 5.8 per cent. of total iron mined in this country as compared with 89 per cent. of red hematite.

"**Bog iron ore** is a variety of limonite found in marshes and swamps. It is a rough, brown ore more or less porous, and earthy. It often contains rootlets, leaves and wood fiber, and occurs in the shallow beds or nodular masses with a low percentage of metallic iron......

"**Oriskany Ores.**—The Oriskany Sandstone of the Devonian often carries in the Appalachian area important deposits of limonite ore, mined at Longdale, Lowmoor, Oriskany, etc., in western part of Virginia, where they average 40 to 43 per cent. iron.

"The Virginia brown ores, according to Eckel (Bulletin 285, p. 183, U. S. Geological Survey), are not original deposits in the Oriskany Sandstone but are replacements of the Helderberg Limestone and adjacent beds of the Oriskany.

Pyrites (FeS_2).

"Iron pyrites is found in all geological horizons and in nearly all localities. It is one of the most common minerals and while usually found in small quantities, large deposits are known and some of these are mined. The mineral usually has a golden yellow color and is mistaken by many people for gold or other valuable metals so that it is often termed 'fool's gold'.

"When pure, pyrites contains 46.6 per cent. iron and 53.4 per cent. sulphur. It is used at a few places as a source of sulphur in the manufacture of sulphuric acid. Attempts to extract the iron after the removal of the sulphur have not been very successful. The value of small deposits of this mineral is nothing.

"Impurities in Iron Ores and Their Effects.

"Iron ore is not found in nature in the theoretical pure form yielding the percentages of metallic iron indicated by the chemical formulae. The percentage of iron is lowered by the presence of chemical and mechanical impurities, some of which seriously interfere with the economic value of the ores.

"CHEMICAL IMPURITIES.

"'**Titanium or Titanic Acid.**—Titanic acid is found in appreciable quantities only in the magnetites, and when over one per cent. is present, it is regarded as harmful, while with over three per cent. the ores are seldom mined or worked at the present time. Titanium increases the infusibility of the slag and results in a loss of iron through the slag. It also, according to Nitze, forms troublesome accretions of hard, infusible nitrocyanide of titanium on the furnace hearth, which in time necessitates a new hearth. The increase in infusibility requires more fuel and therefore higher cost, while the loss of iron through the slag lowers the yield of the ores, so that titaniferous magnetites are looked upon with disfavor and under present prices and conditions are seldom worked.

"**Phosphorus.**—This element is one of the most troublesome and injurious impurities in iron ores. Small percentages render the iron brittle when cold, and the ores are known as **cold-short.**

"Iron has a very strong affinity for phosphorus, so it can not be separated in the blast-furnace and this element remains in the pig iron. Further, any phosphorus present in the fuel or flux will pass into the pig iron and not into the slag. When such pig iron is treated in the acid Bessemer converter, the phosphorus remains in the steel. The maximum allowable limit of phosphorus in ordinary steel is 1-10 of one per cent. Iron ores are therefore classified on basis of phosphorus content into Bessemer and non-Bessemer ores. Phosphorus is usually determined in analysis as phosphoric acid (P_2O_5) and the percentage of phosphoric acid divided by 2.29 will give the percentage of phosphorus.

"A Bessemer iron ore is one in which the percentage of phosphorus in the pig iron made from it will not exceed 1-10 of one per cent. To obtain this maximum limit of phosphorus in a given iron ore, Keep gives a very simple rule;[11] divide the percentage of iron in the ore by 1,000 and the result is the maximum phosphorus limit in a Bessemer ore. Thus, if the ore contains 52.6 per cent. of iron, the minimum limit of phosphorus would be .0526 per cent.

"Nitze[12] used the phosphorus ratio to determine the limit; that is, the amount of phosphorus in 100 parts of metallic iron, which he illustrates as follows: If an ore contained 60 per cent. metallic iron and 0.03 per cent. phosphorus, then 60 per cent. in ore : 100 per cent. in pig iron :: 0.03 per cent. phosphorus in ore : x per cent. phosphorus in the pig iron, or

$$\frac{100}{60} = \frac{x}{0.03} \quad x = \frac{100 \times .03}{60} = 0.05 \text{ per cent.}$$

while 0.10 per cent. represents the allowable limit.

"According to Keep[13] phosphorus produces a very peculiar grain in cast iron, giving a flat fracture with each grain standing clear and alone apparently with low cohesion among the particles which probably explains the brittleness of phosphorus iron, the color of the fracture is white with a tendency to straw color, and such iron is always light in color (Keep).

"Phosphorus lowers the shrinkage of cast iron. Keep states that probably no element of itself weakens cast iron so much as phosphorus when present in quantity over 1.5 per cent.; and it probably does not affect the hardness of the iron, but slightly increases its fluidity.

"According to H. H. Campbell[14], phosphorus up to 0.12 per cent. strengthens steel, but in the rolling mill it tends to produce coarse crystallization and so lowers the temperature to which it is safe to heat the steel, requiring great care in working. In steel for tools and cutlery, phosphorus is especially objectionable as it makes the steel difficult to temper, and a fine cutting edge can not be obtained if .025 of one per cent. of phosphorus is present. Phosphorus in pig iron while it lessens the strength, yet by its increased fluidity makes a metal suitable for fine and ornamental castings, as it readily follows the shape of the mold and gives a greater soundness to the casting as a whole[15].

"In the Basic Bessemer process, the converter is lined with basic material, as calcined limestone or dolomite, which removes the phosphorus from the iron. The same result is accomplished in the Basic Open-Hearth process. According to Wedding[16] (quoted by Nitze) the amount of phosphorus in the pig iron used to the best advantage in these basic processes, should not exceed 3 per cent. Usually pig iron with 2 to 2.5 per cent. phosphorus is used; but with as low percentage as 1.2 no results are reached. The pig iron should be low in silica, not over 1.5 per cent. and not over 0.12 per cent. sulphur and 2.2 to 3 per cent. metallic manganese.

[11] Ore Deposits, p. 77.
[12] Iron Ores of North Carolina, p. 23.
[13] Cast Iron, p. 77, 1902.
[14] Manufacture and Properties of Iron and Steel, p. 469, 1904.
[15] Huntington and MacMillan, Metals, p. 291.
[16] Iron Ores of North Carolina, p. 24.

Sulphur.—The presence of sulphur renders the iron red-short or hot-short; that is, brittle when hot. Manganese when present tends to neutralize the sulphur. This element has a strong tendency to combine with the slag and so is partially removed in the blast-furnace. If sulphur is present in too great quantity in iron ores, it can be removed by washing, before use in the blast-furnace.

"According to H. H. Campbell,[17] sulphur injures the rolling qualities of steel, causing it to crack and tear, and also lessens its capacity to weld, but all these defects can be overcome to some extent by the use of manganese and greater care in heating. In common steel, 1-10 of one per cent. of sulphur apparently does little harm, but in rails it is best to have less than 0.08 per cent. Huntington[18] states that soundness of steel castings and the welding power of steel are both impaired by sulphur.

"**Manganese.**—This element, when present in iron or steel, tends to neutralize the action of sulphur. It also forms a more fluid slag, causing the iron to be more completely separated from its impurities in the blast-furnace.

"According to H. H. Campbell,[19] managnese prevents the coarse crystallization which would be caused by impurities if it were absent, and it also raises the critical temperature to which it is safe to heat the steel. At the present time the maximum allowable limit in steel rails is 0.7 to 1.00 per cent. while in structural steel a higher limit may be used.

"The effect of large proportions of manganese is peculiar[20]. As the percentage of manganese is increased over 1.5 to 2, the metal becomes brittle and almost worthless, and this remains true with further increase until an alloy is formed with 6 to 7 per cent. manganese, when the metal is very hard and becomes tougher when tempered. It thus forms a tough, hard alloy valuable for car wheels, etc., and reaches a maximum toughness when 14 per cent. of manganese is present[21], further addition of manganese causes a sudden decrease in ductility, and over 20 per cent. brings a rapid decrease in breaking load.

"Manganese will replace iron in pig iron to the extent of 85 per cent. or more. Pig iron with 5 to 20 per cent. of manganese is called **spiegel-eisen**, and with greater percentage is called **ferro-manganese**, both of which are used in the Bessemer process.

"**Silicon.**—The element silicon in small quantity appears to have little effect on the ductility or toughness of stell, though some experiments show an increase of 80 pounds to every .01 per cent. silicon up to 4 per cent. and beyond this a decline. Structural steel usually runs .03 to .05 per cent. silicon, while in the best grades of tool steel it runs .20 to .80 per cent.

"According to other authorities[22], silicon makes the metal both hot and cold short, but its effect depends on the relative proportion of carbon. With carbon reaching 0.10 per cent., silicon might be 0.5 or more and not cause the metal to be brittle, while if the carbon was 0.5 per cent., the same amount of silicon could cause the metal to be hot and cold short.

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[17] *loc. cit.* p. 467.
[18] *loc. cit.* p. 231.
[19] *loc. cit.*, p. 463.
[20] Campbell, *loc. cit.* p. 467.
[21] Huntington, *loc. cit.* p. 293.
[22] Huntington and MacMillan, *loc. cit.* p. 288.

"According to Keep,[23] silicon will alloy with iron up to 10 per cent. and by special treatment up to 20 and 30 per cent. and by varying the percentage of silicon in white iron, the softness and grayness can be changed at will. He finds the action of silicon is indirect acting through the carbon which the iron contains. Silicon lowers the saturation point of carbon, or the addition of silicon to iron containing combined carbon expels the carbon in graphitic form which is caught between the grains of the iron, giving it a grayer color.

"The more total carbon or the less combined carbon in the iron, the less the amount of silicon required to produce a given effect. The influence of silicon upon the physical qualities of a casting is important, and by changing the percentage of silicon in an iron mixture, the condition of the carbon can be controlled. Keep[24] gives the following requirements of different grades of iron which by proper mixture give any desired percentage of silicon in the casting:

"White iron contains less than 1 per cent. silicon.
No. 3 Foundry should contain about 1.50 per cent. silicon.
No. 2 Foundry should contain about 2.25 per cent. silicon.
No. 1 Foundry should contain about 2.50 per cent. silicon.
No. 2 Soft should contain about 3.00 per cent. silicon.
No. 1 Soft should contain about 3.25 per cent. silicon.
Silvery iron should contain about 4 to 6 per cent silicon.
High priced silicon iron contains 6 to 10 per cent. silicon.

"**Carbon.**—Carbon in iron up to a certain point increases tenacity and decreases ductility. It also causes the metal when heated and suddenly cooled to harden, the amount of hardening being directly proportional to the amount of carbon present and the rate of cooling[25]. 1.5 per cent. carbon is about the maximum for safe work. Steel with 1 per cent. carbon can be readily welded. Steel with 0.8 to 0.9 per cent. carbon is very useful for high resistance to shock and ability to take a keen cutting edge.

"Iron has strong affinity for carbon and when united at high temperature, forms steel. According to Keep,[26] without carbon iron could not be melted readily and made into castings. The percentage of total carbon determines the melting point of iron; and without carbon, the degree of hardness and strength needed for various uses could not be given. The carbon is absorbed by the ore in the blast-furnace and the iron contains as much carbon as it could possibly absorb under the conditions existing in the furnace. It usually varies from 2 to 4.25 per cent. The largest quantity of carbon that can be absorbed by charcoal iron is 4 per cent., while for coke iron it does not exceed 3.5 to 3.75 per cent. (Keep).[27] In iron with 3 per cent. carbon, this element forms about 12 per cent. of the entire bulk and in pig iron 4 per cent. carbon will form 15 per cent. of bulk of the metal. Carbon increases hardness, fusibility, and fluidity and tends to render the iron crystalline thereby reducing shrinkage.

"**Aluminum.**—The presence of aluminum in iron appears to increase its tensile strength. According to Campbell, 1 per cent. of this element increases tensile strength 3,000 to 8,000 pounds per square inch, and decreases ductility. Keep[28] showed that aluminum alone will make solid gray castings out of porous white iron and he also proved that the aluminum added remained in the casting.

[23] Cast Iron, p. 34.
[24] Cast Iron, p. 41.
[25] Huntington and MacMillan, Metals, p. 278.
[26] Cast Iron, p. 25.
[27] Keep, Cast Iron, p. 29.
[28] *Loc. cit.*, p. 210.

"Aluminum added in small quantity to melted steel, on account of its affinity for oxygen, acts as a deoxidizinz agent and removes carbonic dioxide and increases the solvent power of the fluid metal for gases, thus preventing their evolution at the moment of solidification.[29]

"MECHANICAL IMPURITIES.

"In addition to the chemical impurities in iron ores, considered above, there are often present minerals mechanically mixed with ores. Among the common mechanical impurities are quartz, sand, carbonate of lime, and clay. Quartz or sand, and clay increase the infusibility of the ore and so require greater amounts of fuel and fluxing material, increasing the cost of manufacture. Carbonate of lime present in the ores aids in their fusion and so may be an advantage.

"All of these impurities lower the percentage of metallic iron in a given quantity of ore and therefore increase cost of working as a greater amount of material will have to be handled and treated to secure the same results as in a better grade of ore, and more flux and fuel will be consumed.

"If a large quantity of loose clay and sand is present in the ores, it becomes necessary to crush and wash them, which involves additional cost of equipment and working. If the proportion of these materials is very large, the economic value of the ore is very doubtful. Nitze places the maximum percentage of silica in a commercial ore at about 30 per cent., and suggests that an ore carrying over this amount would hardly be called an iron ore.

On pages 24 to 26 of Volume IV, Dr. Grimsley gives some analyses of iron ores from various States and regions for comparative purposes. These analyses are here repeated, as follows:

"CHEMICAL ANALYSES OF IRON ORES.

"It is often a matter of interest as well as of importance to compare the ores of a State with those mined in other districts, especially is this trpe in a State where the ores occur in quantity but are not as yet developed. For the purpose of comparison a number of iron ore analyses from important districts are given below.

"Magnetite Analyses.

	Cornwall. Pa.[39] Per cent.	North Carolina.[40] Per cent.	Alabama.[41] Per cent.	New York.[42] Per cent.	Sweden.[43] Per cent.
Metallic iron	64.90	63.71	47.83	57.42	56.91
Silica	3.98	11.69	13.00	8.32	....
Alumina	0.324	....	6.98	3.45	....
Lime	1.010	0.16	....	4.46	....
Magnesia	1.131	0.17	....	3.09	....
Phosphorus	0.014	0.003	0.147	0.14	0.009
Manganese	0.158	....	....	0.23	1.31
Sulphur	0.071	0.006	....	0.35	0.036
Copper	0.005	....	....	....	....

[29] Huntington and MacMillan, Metals, p. 297.
[39] McCreath, Geol. Survey of Pa. Annual Report 1885, p. 532.
[40] Nitze, Iron Ores, North Carolina, p. 77.
[41] Winchell, Iron Ores of Minn. Bull. VI, p. 90.
[42] Blake quoted Iron Ores of Minn. Bull. VI, p. 88.
[43] Blake quoted Iron Ores of Minn. Bull. VI, p. 92.

"Analyses of Lake Superior, Hematite Ores.[44]

	Gogebic. Ashland Mine Per cent.	Marquette. Salisbury Mine Per cent.	Menominee. Florence Mine Per cent.	Mesabi. Biwabik Mine Per cent.	Vermilion. Savoy Mine Per cent.
Metallic iron	53.40	52.06	49.43	56.42	60.71
Silica	6.54	6.62	5.78	3.40	3.89
Alumina	2.75	2.00	3.21	1.60	....
Lime	0.222	0.50	1.27	0.45	....
Magnesia	0.231	0.44	2.37	0.24	....
Sulphur	0.008	0.010	0.116	0.007	....
Manganese	0.240	0.516	0.20	0.417	0.93
Phosphorus	0.040	0.110	0.279	0.040	0.041
Loss by ignition ..	2.45	2.07	4.24	3.90	....
Moisture	11.00	12.50	10.46	9.34	5.71

"The following analyses are taken from the Cargo Analyses for 1900 of same mines shown in the above table for 1906. A comparison of the two tables shows a decline in percentage of metallic iron for three of the mines. Eckel, in report quoted above, figures the average decline of the Lake Superior ores for past five years as about 1 per cent. a year in iron content.

	Gogebic. Per cent.	Marquette. Per cent.	Menominee. Per cent.	Mesabi. Per cent.	Vermilion. Per cent.
Metallic iron	54.636	52.17	49.20	59.47	59.30
Silica	....	6.303	5.80	2.22	3.21
Alumina	....	2.139	3.41	0.842	....
Lime	....	0.355	1.36	0.157	....
Magnesia	....	0.407	2.67	0.083	....
Sulphur	....	0.0095	0.114	....	....
Manganese	....	0.2286	0.36	0.592	....
Phosphorus	0.039	0.094	0.281	0.034	0.048
Loss by ignition ..	....	2.269	4.93	3.496	....
Moisture	11.03	13.05	9.93	7.51	6.71

"Analyses of Clinton Fossil Hematite Ores.

	Lowmoor, Va.[45] Per cent.	Birmingham, Ala.[46] Hard ore. Per cent.	Soft ore. Per cent.	Kentucky.[47] Per cent.	Penna.[48] Per cent.
Metallic iron ..	57.00	54.70	37.00	36.00	50.10
Silica	7.12	13.70	7.14	7.80	16.95
Alumina	6.31	5.66	3.81	5.132	4.49
Lime	1.46	0.50	19.20	13.080(carb)	0.56
Magnesia	0.08	..	....	9.444(carb)	0.342
Phosphorus ...	0.672	0.10	0.30	0.497	0.268
Manganese ...	0.15	0.23	0.23	....	0.475
Carbon dioxide	1.23	....	....	....	....
Sulphur	....	0.08	0.08	....	0.014
Water	1.18	....	....	....	4.753

[44] Avg. Cargo Analyses Lake Superior Iron Ore Association 1906, quoted by Eckel, U. S. G. S. Mineral Resources, 1906.

[46]Eckel, U. S. G. S. Bull. 285, p. 188

[46]Eckel, U. S. G. S. Bull. 315, p. 135.

[47]Kindle, U. S. G. S. Bull. 285, p. 181.

[48]McCreath, Penn. Geol. Sur. Report M3, p. 39.

"Analyses of Limonites.

	Alabama[49].	Covington, Va.[50]	New Riv. Va.[51]	North Carolina.[52]	Ohio.[53]	Pennsylvania.[54] Center Co.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Metallic iron	58.459	36.96	43.76	49.29	39.2	57.10
Silica	2.864	33.26	13.52	7.63	13.61	4.53
Alumina	1.411	5.26	1.79	....	3.00	1.49
Lime	0.407	0.28	....	....	2.90	trace
Magnesia	0.045	....	....	....	1.95	0.47
Phosphorus	0.332	0.573	0.17	0.663	0.014	0.07
Manganese	0.188	0.61	0.58	0.060	....	0.10
Sulphur	0.085	0.014	....	....	0.34	....
Combined water	11.849	....	....	....	....	....
Moisture	0.833	1.90	....	....	....	11.70

Analyses of Siderite Iron Ores.

	Blackband ores, Ohio.[55]		Perry County, Pa.[56]
Iron carbonate	45.86	43.26	....
Iron sesquioxide	7.40	8.94	....
Silica	25.52	11.84	13.27
Alumina	0.50	trace	3.475
Lime carbonate	1.50	1.87	0.510 (oxide)
Magnesium carbonate	3.26	2.03	0.335 (oxide)
Manganese	2.10	1.00	0.490
Phosphorus	0.043	....	0.189
Sulphur	0.17	0.18	0.042
Volatile and combust. matter	13.30	30.50	13.740
Metallic iron	27.32	27.12	47.25
Iron in calcined ore	43.94	....	....

Chapter III of Volume IV of the Survey treats of The Origin of Iron Ores. The data by Dr. Grimsley pertinent to Hampshire and Hardy County iron ores are here reproduced from pages 72 to 76, as follows:

"ORIGIN OF THE WEST VIRGINIA IRON ORES.

"Clinton Fossil Hematite.

"The origin of the Clinton fossil hematite is usually ascribed to the replacement of limestone by iron brought in solution, though Eckel and a few others have regarded the Alabama Clinton ores as original sea deposits formed at the same time as the enclosing rocks.

"The Clinton fossil ore is found in widely separated localities, with similar structure, and with fossils preserved in it often in large numbers. There is a marked similarity in the ore of Wisconsin, Ohio,

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[49] McCalley quoted U. S. G. S. Bull. 315. p. 154.
[50] Eckel, U. S. G. S. Bull. 285, p. 187.
[51] Holden, U. S. G. S. Bull. 285, p. 191.
[52] Nitze, Iron Ores of North Carolina, p. 115.
[53] Lord, Ohio Geol. Survey, Vol. V, p. 496.
[54] McCreath, Geol. Survey of Pa. Summary Final Report, Vol. I. p. 384.
[55] Ohio Geol. Survey. Vol. V., pp. 401, 460.
[56] McCreath Geol. Survey of Pa. Report M3, p. 31.

Alabama, New York, Pennsylvania, West Virginia, etc. Hand specimens from these different localities would be difficult to separate.

"The theory of replacement would hold that the ores in these different localities were formed at the same period of geological time (Clinton), and under similar, if not identical conditions, giving an almost uniform structure and with fossils preserved in same manner. Such conditions did not hold in the replacement of limestone by iron before nor since Clinton time, because other iron deposits, as for example the Oriskany ores, vary in structure and character often in the same limited area; and in the example cited, the fossils of the replaced fossiliferous Helderberg Limestone have in all cases completely disappeared.

"It may be assumed by the replacement theory, that in the case of the Clinton limestone alteration, the change was so slow and gradual that the fossil structures were preserved, but if so the limestone structure was lost for the iron ore has a distinct laminated structure, also a granular and oolitic structure quite different from the compact Clinton limestones. The ore also breaks in oblong blocks very different from the limestone. This might be explained as a secondary structure, the result of mountain-making forces, but the ore in Ohio has a similar structure where marked folding is absent. A slow process of molecular replacement which would explain the preservation of the fossil forms, would at the same time preserve the limestone structure which is lost in these ore beds. The fossils in the West Virginia Clinton ore often have an outer shell of white lime carbonate which by theory of replacement should not remain.

"'The Clinton ore of West Virginia in Pendleton County has a flat scaly structure as if the iron particles had been rolled by wave or current action. In Grant County this structure changes to a granular and oolitic structure and the silica content is higher, increasing to the north at Keyser, in Mineral County, where the so-called iron ore contains 48 and 54 per cent. silica. The Keyser ore would more properly be called a ferruginous sandstone. The fossils, however, are partially preserved, the rock breaks along parallel planes and by jointing into oblong blocks, a similar structure to the richer Clinton ores at the south. The relation of the bed to the surrounding rocks and its thickness are similar to the ore at the south. There is apparently an increase in iron and decrease in silica in this Clinton bed as followed south through Grant into Pendleton County.

"At no place in this Clinton horizon are blocks of limestone or any trace of a limestone bed found in the deep ravines or mountain folds. If the ore was formed by replacement, the operation was most complete, involving a total change of the limestone and the percentage of lime carbonate in the ore averages only 1½ per cent. and is often under one per cent.

"The rocks of the Clinton series in this State are shales, clays, sandstone, and an absence of limestone. If there was originally a bed of limestone now replaced by ore, the stratum was a very irregular one, varying in thickness from 6 inches to 3 feet. It expanded and contracted from place to place in a most irregular manner; a relation very unusual for limestone, but often present in sandstones and other shallow-water rocks.

"By the theory of original sea deposition of this iron ore it would be formed in the Clinton sea in same manner as the sandstone and shales. The iron was then precipitated and mixed with sand and clay in which fossils were preserved. The oolitic structure would imply a concretionary deposit, the iron being precipitated around sand grains in concentric form. In some portions of the sea, as in the Keyser area, there was only a slight precipitation of iron in the sand.

"The difficult factor to account for in this theory is the quantity of iron available for this deposit in the Clinton sea, apparently not duplicated at any other time before or since. There must have been at this time an exceptional quantity of iron present; its source is difficult to explain. There are thus encountered in both theories factors almost impossible to account for; but it seems to the writer that the theory of original deposition offers a more satisfactory explanation of the origin of these West Virginia Clinton ores, than that of replacement.

"Brown Hematite or Limonite.

"The limonite or brown hematite iron ore beds are found near the contact of a limestone and sandstone with a shale deposit above. The limestone along this contact has for the most part disappeared, only boulders here and there giving evidence of its former existence. The iron ore is imbedded in fine shales or clays, and its upper wall is a sandstone into which stringers of ore may extend. In some places the lower surface of the sandstone is covered by a plate of ore varying in thickness from a fraction of an inch to 10 inches. In some of the deposits small blocks of sandstone are imbedded in the ore mass, and sandstone and ore are quite intimately mixed in other deposits.

"The shales overlying the Oriskany Sandstone above the ore bodies have been estimated as 2,500 to 3,700 feet in thickness (U. S. G. S.). An analysis of this shale at the present time shows 4 to 5½ per cent. iron oxide. Pyrite was not found in this shale, though it is possible that the unaltered rock may contain this mineral. One square mile of this shale 3,000 feet thick with 5½ per cent. iron oxide would contain 356,495,040 tons of iron oxide, while the total tonnage of iron ore in Hardy County is only estimated at 100,000,000 tons. With this large quantity of iron oxide present in the weathered rocks, the loss of shales by erosion, and the loss of iron in the weathered shales would be more than sufficient to account for the present iron ore deposits, if the iron was concentrated in this Oriskany-Helderberg contact horizon by some geological chemical agency.

"Circulating ground waters would contain iron taken into solution in its passage through the shales and would pass through the Oriskany Sandstone until it reached the Helderberg Limestone. The iron water would dissolve the lime carbonate, leaving its iron thus replacing the limestone to a greater or less depth. Probably more lime would be removed than is replaced by iron, so that the resulting formation would be porous. This Oriskany ore is characterized by its porous or honeycomb structure, and it often shows a concentric shelly structure characteristic of minerals formed from solution.

"Blocks of the overlying sandstone would sometimes be caught in these limestone cavities, and later be completely enclosed in the iron. In some deposits the ore next to the sandstone is very sandy and consists of a mixture of sand and ore, a structure well known in the old Warm Spring mine on Capon Furnace tract, Hardy County.

"The ores are not deposited in the Oriskany Sandstone but in the place of the Helderberg Limestone and, as Eckel pointed out in his Virginia ore studies, would be more correctly named Upper Helderberg iron ores. Since the resistant Oriskany Sandstone forms a good guide to the location of this ore horizon and since the term is so well established in geological literature and among mining operators, it seems best to retain the name Oriskany ores. These Oriskany ores in West Virginia are regarded as due to limestone replacement by iron."

As the old-time furnaces in Hampshire and Hardy Counties were Charvoal Blast-Furnaces and as a few of these are still standing, the description by Dr. Grimsley of "Charcoal Blast-Furnace" given in Chapter IV of Volume IV (pages 77 to 81) of the Survey is very interesting and is here reproduced, as follows:

"CHARCOAL BLAST-FURNACE.

"The early blast-furnaces of this country were designed for the use of charcoal fuel. They were built of native stone, usually limestone or sandstone, 30 to 40 feet high, though a few more modern furnaces reached a height of 85 feet. They were square in section 15 to 20 feet in size, tapering toward the top, and in many places were built against a bank or hill with top level with the bank so as to facilitate charging. The old West Virginia furnaces were built some distance from the bank and connected by a broad platform bridge. In the interior they were lined with fire brick and made widest in the bosh, 10 to 12 feet in diameter, tapering below in the hearth to 3 or 4 feet and gradually toward the top to about 3 feet.

"The hearth in the Ohio furnaces[1] was 4 to 6 feet high with diameter at bottom of 2 to 3½ feet. The Capon Furnace, in Hardy County, West Virginia, had the hearth 5 feet high, 22 inches diameter at bottom and 24 inches at top with two tuyeres for air blast, 17 and 18 inches above bottom of the hearth with a 2¾-inch nozzle and air pressure of ½ to ⅝ pound. An arch was made near the bottom of the furnace on one side with its lower part closed by a dam-stone 14 inches high, and the metal was tapped through a hole in the bottom of this stone while the slag passed through a notch at the top and flowed down over the ground and, after cooling, was carted away.

"The bosh above the hearth in the Ohio furnaces was 9 to 12 feet high with diameter 9 to 12 feet. The stack above the bosh was 22 to 50 feet high with diameter at top of 2½ to 3½ feet. The blast used in these furnaces was one of three kinds, cold blast of ordinary air, warm blast, or hot blast. The latter two had the air heated in special stoves, or the hot gases from the stack were drawn off through a pipe to a stove or furnace located at level of top of the stack and fitted with vertical or horizontal pipes. Cold air was admitted and drawn off below, heated and forced through the tuyeres. The temperature of the blast in this method was about 700 to 800° F., according to Lord.

"The furnace was filled from the top introducing a weighed quantity of ore and limestone forming the charge, and a measured amount of charcoal, the fuel and charge forming alternate layers. In starting the furnace it was customary to first place 30 to 35 blank charges of charcoal for burning the lower part of the furnace to the required temperature. The Capon Furnace, in West Virginia, during the first week after starting produced 10 to 12 tons of pig iron a

[1]Data on Ohio furnaces from Lord, Ohio Geol. Survey, Vol. V, pp. 503-513.

week, and under exceptional conditions 18 to 20 tons a week. The average charge for producing one ton of pig iron was about 174 bushels of charcoal, 1,558 pounds of limestone and 5,172 pounds of ore. This ore had the following composition, according to an old analysis by Guerard:[2]

	Per cent.
"Iron sesquioxide	64.287
Manganese binoxide	7.680
Silica	11.771
Alumina	3.184
Lime	2.657
Magnesia	1.141
Phosphoric acid	1.110
Sulphuric acid	1.180
Water	6.695
Loss	0.295
	100.00
Iron	45.00
Phosphorus	0.483
Sulphur	0.427

"In West Virginia there have been a considerable number of old charcoal iron furnaces scattered over the State, but most of these have been destroyed, and a pile of loose rock with a small remnant of the stack marks their original site. The smooth and uniform cut blocks of stone were regarded by the farmers as more valuable for foundations of houses and barns than to be left in the original stack. In Hardy County two of these old furnaces are standing in fairly good state of preservation. The Crack Whip Furnace, seven or eight miles southwest of Wardensville, and the Capon Furnace six miles south are well preserved. The old furnace at Bloomery in Hampshire County has the stack in apparently as good condition as when it was in use. The records of the old works are difficult to locate but a number of the books of the Capon Furnace have been preserved and were kindly loaned by Messrs. Volney and DeVan Keller, sons of the former proprietor and who now own the property. From the blast-furnace book the following records were taken of two weeks run in 1869, and one week in 1870:

[2] Resources of West Virginia, by Maury, 1876, p. 269.

Nov. 1869		No. charges.	Bushels charcoal daily.	Weight ore in pounds per charge	Pounds of ore daily.	Limestone pounds per charge	Limestone pounds daily.	
Sun.,	21	20	280	450	9,000	100	2,000	
	22	26	364	400	10,400	100	2,600	
	23	27	378	500	13,500	100	2,700	
	24	30	420	450	9,500	100	3,000	
	25	31	434	400	12,400	100	3,100	
	26	21	294	400	8,400	100	2,100	
	27	26	364	400	10,400	100	2,600	
	28	19	266	400	7,600	100	1,900	
	29	26	364	400	10,400	100	2,600	
	30	25	350	400	10,000	100	2,500	
Dec.	1	28	392	400	11,200	100	2,800	
	2	32	488	400	12,800	100	3,200	
	3	25	350	400	10,000	100	2,500	
Sat.,	4	17	238	400	6,800	100	1,700	23 tons
		353	4,942		141,900		35,300	pig made
July, 1870.								
Sun.,	24	10	140	400	4,000	100	1,000	
	25	23	322	400	9,200	100	2,300	
	26	24	336	400	9,600	100	2,400	
	27	24	336	400	9,600	100	2,400	
	28	20	280	400	8,000	100	2,000	
	29	22	308	370	8,000	100	2,200	
	30	23	322	370	8,000	100	2,300	11 tons
		146	2,044		56,400		14,600	pig made

"From the records, the weekly production of pig iron in tons in 1870 was:

19½	14	13¼	15¼	14½
21½	14	12	14	16
16½	13	12½	12	17

"From a study of the records, the following charges were determined at different times, to make one ton of pig iron:

DATE.	Bushels Charcoal.	Pounds Limestone.	Pounds Ore.
December 5 to 11, inc. 1869	215	1,534	6,170
December 19 to 22, inc., 1869	150	1,069	4,615
January, 1870	209	1,561	6,060
February, 1870	190	1,352	5,991
February, 1870	190	1,605	6,026
March, 1870	174	1,558	5,172
March, 1870	169	1,493	5,184
May, 1870	201	1,491	6,323
1870	188	1,345	5,567
1870	191	1,637	5,619
1870	175	1,248	4,992
1870	152	1,084	4,537
1870	200	1,505	6,379
1870	201	1,491	6,323
Average	186	1,426	5,697

In Chapter V of Volume IV, Dr. Grimsley gives a short History of the West Virginia Iron Industry by counties. The following items concerning Hampshire County are taken from pages 136-9 of that volume while those quoted on Hardy County are from pages 142-6:

"Hampshire County Iron Industry.

"In Hampshire County, 12 miles south of Romney, was located an iron furnace known as the Hampshire Furnace, which, according to Maxwell and Swisher,[10] was built by Edward McCarty somewhere near 1800. Old county records show a prosperous business at this furnace in 1816 and 1817, but no later account has been found, and the furnace was torn down many years ago.

"According to the history above quoted, the Bloomery Furnace, in the eastern part of the county, was built in 1833 by a Mr. Pastly (Priestly) and a few years later was owned by Passmoor, who placed a man named Cornwell in charge. He operated the furnace until 1846, and transported the iron on rafts and flatboats down the Cacapon River.

"S. A. Pancoast bought the property in 1846 and operated it to his death, in 1857. It was then operated by his heirs under the name of Pancoast and McGee. John Withers was superintendent until 1875, when the furnace was closed down. It was operated for a short time in 1880 and 1881. The U. S. Census Report for 1880 gives the following data on this property:

Maximum annual capacity.......	8,500 short tons.
Iron ore production in 1880	7,000 short tons (fossil ore.)
Value of ore in 1880............	$10,500
Number of employes in 1880......	25
Value of plant	$ 6,000
Value of real estate	10,000
Capital invested	17,000

"The same report gives the following analyses by Whitfield of the ores used at the Bloomery Furnace:

	Natural Ore.		Dried Ore.		Phosphorus. Ratio.
	Phosphorus.	Metallic Iron.	Phosphorus.	Metallic Iron.	
I	0.086	38.04	0.087	38.40	0.226
II	0.286	49.53	0.294	50.94	0.577
III	0.996	47.05	1.011	47.78	2.117

I. Across breast, ore 12 feet thick, avoiding interbedded clay at furnace. Limonite.

II. From 500 tons at furnace, brought from northeast of furnace. Fossil.

III. From 100 tons at furnace, brought from southwest of furnace. Fossil. Titanium present.

[10] History of Hampshire County, p 533; 1897.

"Maury (p. 271) in 1876 quotes Guerard as follows on this property: 'Here a fossiliferous variety of brown hematite occurs in a vein, varying from 18 inches to 4 feet. This and a vein of the ordinary brown iron ore (thickness not known) have been mined and smelted here for many years. The furnace has been out of blast for the last few months, but will probably soon be in operation again. Limestone, charcoal and fine water power are easily obtained anywhere along this valley. The following are the general proportions of the charge and the production of the furnace, as given me by Mr. Withers, the present manager and part owner:

Cold blast { 800 pounds limestone; 120 bushels charcoal; 2½ to 2¾ tons raw ore. } to 1 ton pig iron.

"Cost $20.00 per ton pig delivered at Pawpaw station, distant 14 miles.

"Mr. Maury (p. 272) gives the following analyses made by Dwight in 1875 of two brown hematite ores from Short Mountain, 15 miles south of Romney:

	Per cent.	Per cent.
"Sesquioxide of iron	73.531	75.250
Binoxide of manganese	4.380	Trace
Silica	13.329	12.035
Alumina	3.025	2.199
Lime	0.024	1.254
Magnesia	0.251	0.631
Phosphoric acid	0.241	0.089
Sulphuric acid	1.204	2.058
Combined water	3.082	0.750
Hygroscopic water	0.632	0.631
Loss	0.301	0.524
	100.000	100.000
Iron	51.471	52.675
Phosphorus	0.105	0.038
Sulphur	0.481	0.823

"The McCarty charcoal furnace near Paddington railroad station in Hampshire County is described by Lesley as standing in 1856 but abandoned 30 years before.

"Hardy County Iron Industry.

"Mr. Guerard also reported on the iron ores in Hardy County in 1875-6 given in the Maury report (pp. 267, 268):

"On the west side of Elkhorn Knob, 13 miles south from Moorefield, three separate seams of the rcd fossiliferous hematite crop out with the usual favorable characteristics of this valuable formation. They measure respectively:

(1) 0 feet, 8 inches }
(2) 1 " 6 " } Ketterman's farm.
(3) 3 " 3 " }

"The upper ores of this group are remakably well shown on the same range:

(1) Red hematite, 25 feet (16 feet solid ore)—Pine Mountain, 1½ miles from Ketterman's.

(2) Brown hematite. 30 feet (from outcrop)—Salt Spring Run Knob, ʲ miles from Ketterman's.

(3) Brown hematite (very pure), 14 feet—Cunningham's tract, 3 miles from this and 9 from Moorefield.

"The brown hematites occur largely again on the spurs and ridges of the North or Cacapon Mountain. These have long been mined and smelted by various iron works in this portion of the county. The only furnace now in existence (1876), is that known as the Capon Iron Works, six miles from Wardensville on the east side of the mountain.

"The following data show the general charge and working of the Capon Furnace:

Cold blast at ⅝ pound pressure.	800 to 1,000 pounds limestone 140 to 160 bushels charcoal 2 to 3 tons charred ore	to 1 ton pig iron.

25 to 30 tons pig iron a week.
Cost $15 per ton at works.

Shipping point Winchester, distance 20 miles.

"The ores worked are said to produce an excellent quality of iron, especially adapted to the manufacture of car wheels and boiler plate.

"Of the furnaces formerly worked, but now abandoned, there are three in this county: One on Orr's Mountain, west of Moorefield and two on the east side of the mountain. In the neighborhood of Wardensville Messrs. Saliard and Bryan carried on a furnace many years ago, and 8 miles from Capon Iron Works, on the same range, was the Crack Whip Furnace, owned by Charles Carter Lee. A large deposit of ore was developed in this locality, as shown by the old workings still exposing several feet of solid ore."

"Bryan's charcoal furnace, on the Hezekiah Clegget farm, was abandoned in 1840.

"Maury gives the following analyses of Hardy County ores, as made by C. E. Dwight:

	I. Per cent.	II. Per cent.	III. Per cent.	IV. Per cent.
"Sesquioxide of iron	84.800	72.990	83.470	64.287
Protoxide of iron	......	......	4.640	......
Binoxide of manganese	......	......	Trace	7.680
Silica	5.900	23.500	9.400	11.771
Alumina	......	......	1.810	3.184
Lime	......	......	......	2.657
Magnesia	......	......	......	1.141
Phosphoric acid	1.600	0.122	0.373	1.110
Sulphuric acid	0.100	0.870	0.120	1.180
Water	.....	......	......	6.695
Water and Loss	4.600	2.518	0.187	......
Loss	.....	......	......	0.295
	100.000	100.000	100.000	100.000
Iron	59.360	51.090	62.010	45.000
Phosphorus	0.698	0.053	0.163	0.483
Sulphur	0.040	0.035	0.048	0.472

I. Red fossil hematite from 3 feet, 3-inch seam on Ketterman farm.
II. Red hematite from 25-foot vein on Pine Mountain.
III. Brown hematite from 14-foot vein in Cunningham tract.
IV. Brown hematite (Half Moon mine) from Capon Iron Works.

"The old Capon Furnace, six miles south of Wardensville, is still standing in fair condition of preservation. It had a capacity of 4 tons and was built before April, 1832, for in that year is recorded the reorganization of the Capon Furnace Company, by the formation of the firm of James Sterrett & Brother (Alexander M.). It was built by the former according to Lesley, in 1822, and the value placed on the property at this time, in 1832, was $15,000. James Sterrett died in 1834, and the furnace was operated to Aug. 12, 1835, by the administrator of his estate. The old book account gives no record from 1835 to 1856, but in the latter year the property was sold to J. J. Keller and was then known as Capon Iron Works. It continued in operation until 1875, when it was shut down. The accumulated ore on the dump was worked up by a short run in 1880 and then the plant was permanently abandoned. It cost $10 a ton to transport the pig iron across the mountain to the railroad, which made a total cost of $25 a ton for the iron at the railroad. The average price of the iron during the successful career of the furnace was $40 to $60 a ton, but after price declined to $25 and $30 the work proved a failure.

"A forge was bulit near the furnace near the end of its active history, but yielded little profit.

"Lesley, in 1866, states the forge was equipped with two hammers driven by water power, four fires; and made in 1855, 220 tons of blooms and bars. The furnace was 30 feet high, 9-foot bosh. An old circular bill of sale of the company lists the equipment as follows:

"One horizontal stationary steam engine, common slide or D valve, 11-inch bore and 30-inch stroke, rated 30 horse-power.
One set blowing cylinders (two cylinders) bore 37-inch, stroke 38-inch, all connections and gearings complete.
Lot of hand and standing ladles, part of cupola outfit.
One steam hammer, 9-inch bore, 34-inch stroke or drop for bloom.
Two cylindrical boilers (iron) 31-inch diameter, 38 feet long.
Two sets forge fire castings and one run-out.
One rock crusher, Blake pattern, 10-inch by 7-inch, complete.
One six-ton track scale used for weighing ore on tramway, complete.
Castings for double ore wash, paddle pattern, complete.
One 1-ton platform scale for bridge house barrows.
Castings for sawmill carriage and feed gear, complete.
Lot of tools for forge and blacksmith.
One turbine wheel (new) 8 horse-power.
Land, 4,100 acres.
Twelve miners' cabins, one six-room cottage, stables and sheds.

"The U. S. Census Report for 1880 gives the following data on Capon Furnace:

"Maximum annual capacity	6,720 short tons.
Iron ore production in 1880	448 short tons limonite.
Value of production in 1880	$ 400
Number of employes in 1880.........	6
Value of plant in 1880	$ 150
Value of real estate	25,000
Capital invested	25,150

"The Census returns for the State in 1880 are as follows:

"Number of furnaces	8
Maximum annual capacity	140,520 short tons
Total production in 1880	60.371 short tons
Total value of ore in 1880	$ 91,057
Number of employes	266
Total capital invested	$115,550"

In the Mineral and Grant County Report (page 699) of the Survey by David B. Reger, published in 1924, the following remarks by Reger concerning the Adam Ketterman Heirs Prospect are given:

"**Adam Ketterman Heirs Prospect.**—At the Adam Ketterman Heirs Prospect, located in the edge of Hardy County at the summit of the mountain road which passes from Masonville to Brake and 1.5 miles southeast of the former place, at elevation 2375′ B., a considerable amount of hematite has been exposed, apparently at the Fossil Ore Horizon. The section is not visible at the present time but a sample (No. 566R) collected from the dump shows 50.66 per cent. of metallic iron, as indicated in the Table of Iron Ore Analyses at the end of this subject (Iron Ore)."

The analysis of this sample (No. 566R) was published on page 707 of the Mineral-Grant Report, and is as follows:

	Per cent.
Silica (SiO_2)	8.85
Ferric Iron (Fe_2O_3)	72.43
Alumina (Al_2O_3)	8.70
Lime (CaO)	2.46
Phosphoric Acid (P_2O_5)	0.09
Loss on Ignition	7.41
Total	99.94

A sample of the ore from the Ketterman prospect was also taken by Grimsley, but in the table on page 280 of Volume IV, he has tabulated it with analyses of samples from Grant and Mineral Counties. Tucker also sampled the ore from this property, the analysis of which is given on page 408 of this Report. The analysis of Grimsley's sample shows 56.00 per cent. metallic iron, against Tucker's 42.70, and Reger's 50.66. The complete analysis of the ore from the Ketterman prospect collected by Grimsley is as follows:

	Per cent.
Iron Oxide	80.00
Silica	6.81
Manganese Dioxide	0.04
Phosphorus	0.46
Sulphur	0.002
Lime Oxide	1.64
Moisture	0.60
Loss on ignition	3.44
Titanium Oxide	0.07

The following statements concerning the iron ores of Mineral and Grant Counties, which adjoin Hampshire and Hardy on the west, are taken from Reger's Mineral-Grant County Report of the Survey, since they are more or less pertinent to the area under consideration:

"The Oriskany ores are lean and lenticular, being usually mere pockets of ocherous or siliceous material and can not be regarded as a valuable mineral resource, although attempts have been made to work them and they are therefore of both historical and scientific interest.

"The Clinton ores consist of the quite persistent and often fairly rich **Fossil Ore Horizon**, coming within a few feet of the top of the series, and the equally persistent but quite siliceous and lean **Iron Sandstone**, lying near the bottom of the series and only a few feet above the White Medina Sandstone. The Fossil Ore Horizon was formerly considered as a fairly continuous sheet of ore but the fact that it is only a surface enrichment of a fossiliferous limestone was pointed out many years ago by Dr. I. C. White (Report G7, Second Geological Survey of Pennsylvania, p. 112; 1883). The Iron Sandstone, on the contrary, is not known to decrease perceptibly in ferruginous content with depth and appears to have derived its iron content from some unknown source at a period much more remote than that in which segregation of the Fossil Ore occurred. It is quite possible the Iron Sandstone, in many cases, is the primary source of the Fossil Ore, since the latter is usually found best developed at the foot of anticlinal mountains where the Iron Sandstone outcrops at a higher level toward the crown of the arch, so that the flow of surface waters from the sandstone is down the slope toward the fossiliferous limestone of younger age. A sufficient amount of investigation has not been made to justify the statement of such a theory as a positive belief but it is quite significant that in both Greenland and Kline Gaps, Grant County, where the Iron Sandstone is raised to a high level on New Creek Mountain, it is abnormally lean in iron while the Fossil Ore Horizon at the base of the mountain is thicker than usual and quite rich in ore. At the same time the Iron Sandstone occurring just above drainage at the northern end of Abrams Ridge, near Keyser Mineral County, is much richer in iron than at either Greenland or Kline Gap, while the Fossil Ore both east and west of the old Alkire mine at Abrams Ridge can scarcely be found, its horizon having received no drainage from the sandstone outcrop."

Concerning the iron ore prospects (in Mineral and Grant Counties) in the Oriskany Sandstone, Reger makes the following remarks, pages 692 and 694, Mineral and Grant County Report of the Survey:

"The lenticular nature of the Oriskany iron deposits has already been mentioned. These occur at isolated localities, being usually in the form of soft, ocherous material which often leaches from the sandstone and is caught in adjacent absorbent material.****

"In Grant County no attempt has been made to use the Oriskany ore and apparently there is none that may ever be worked. On the south end of Patterson Creek Mountain, 1 to 1½ miles northeast of Petersburg, the outcrop of the Oriskany is ferruginous but not sufficiently so to class it as an iron ore. In the public road just north of Kessel, Hardy County, about 1½ miles east of the ridge of Patterson Creek Mountain, there is visible a small deposit of ocherous ore in the top of the Oriskany. The outcrops of the Oriskany throughout Grant County are abundant but there appears to be no possibility of it containing commercial ore."

Concerning the iron ore prospects of Mineral and Grant Counties in the Clinton Series, Reger makes the following statements on pages 694 and 699 of the Report on these counties:

"In the Clinton Series of the two counties there appear to be only two iron-bearing horizons, the Fossil Ore Horizon at the top of the series and the Iron Sandstone near the base. At other levels there are occasional small ferruginous lenses, but they are not consistent and are so insignificant as to require nothing more than a passing remark."*******

'The **Iron Sandstone,** which constitutes the lower belt of the Clinton Iron Ores, is well exposed in both Mineral and Grant Counties, being an abundant and persistent deposit at nearly all points along its extensive outcrop. Its value as an ore, however, is subject to much doubt, since it has a silica base and the iron content is quite low. It may be regarded as a low-grade ore reserve which should be let alone until such time as the exhaustion of better material or the development of improved blast-furnace practice may make its exploitation feasible."******

Reger, in making estimates of the available iron ore in Grant and Mineral Counties, assumed a thickness of one foot for the Fossil Ore Horizon in Mineral County, 2 feet for Union District and 3 feet for Grant and Milroy Districts, Grant County, while for the Iron Sandstone, the assumed thicknesses were: Frankfort District, Mineral County, 20 feet; New Creek District, Mineral, 15 feet; Grant and Union Districts, Grant County, 25 feet; Milroy District, 30 feet. The weight of the Fossil Ore he found averaged 268 pounds to the cubic foot, while the Iron Sandstone averaged 202 pounds, based on a metallic iron content of 38.7 per cent. for the Fossil Ore and 17.1 per cent. for the Iron Sandstone, with the combined sandy and calcareous residue assumed as 150 pounds and the weight of pure iron as 454 pounds per cubic foot. The outcrop of the two horizons in the several districts was measured. The tonnage in the ore reserve was then computed on the basis of a mining depth or width of 500 feet, concerning which he makes the following remarks (page 704):

"On the subject of mining depth or width, whichever it may be termed, the assumption is much more speculative. In the case of the Fossil Ore Horizon it has already been pointed out that this bed is considered as a limestone replaced by iron at the surface and gradually decreasing in ferric content with depth, this conclusion having been reached by Dr. I. C. White many years ago in his study of the same bed in Pennsylvania where, in many localities, it has actually been mined to a depth where the iron has practically disappeared. If it stood in a vertical position it is quite probable that increasing costs and decreasing iron would cause the abandonment of mining at a depth of not more than 250 feet but its dip on the eastern sides of the anticlines where it is brought to the surface is usually only 20 to 40° and on the western sides, where folding is more abrupt, it varies from 50 to 70°, making a probable average of 45° which in practice will be further reduced by an average descending topographic slope of at least 15° so that the net dip for computing depths to the ore body will not be more than 30°. On the basis of percolation and replacement to a vertical depth of 250 feet the width of the strip of ore that may be mined becomes approximately 500 feet and this figure has been used in making the estimates."***

"In the case of the Iron Sandstone the iron is considered as connate so that its percentage will not decrease with depth and may even slightly increase because there will be no leaching. On the other hand it is apparent that this horizon may be utilized only where the costs are a minimum such as may be had in stripping or other surface methods. This assumption would appear to preclude the recovery of any appreciable amount of the ore but in actual fact its bed often makes the surface of long mountain slopes, especially on their eastern sides where the dip is more gentle. Such being the case it is believed that the same average width of 500 feet, as used for the Fossil Ore Horizon, will be a conservative figure for the Iron Sandstone and it is accordingly used."****

Grimsley's estimate of the Iron Ore resources in eastern Hardy and Hampshire Counties, given on a preceding page, was 75,000,000 tons, based on a 50-mile outcrop, with a width of 15 feet, and a depth of 200 feet, making 30,000,000 cubic yards. This gives a weight of only 180 pounds to the cubic foot. The average metallic iron content of the 37 samples given in Grimsley's table for the Hardy County area was 42.79 per cent., which would equal 194.2 pounds of pure iron in a cubic foot of ore, while the remaining 57.21 per cent., if assumed to weigh 150 pounds per cubic foot, as used by Reger in estimating the iron-ore resources of Mineral and Grant Counties, would weigh 85.8 pounds, or a total of 280 pounds per cubic foot of ore, or 12 pounds heavier than Reger's estimate for the Fossil Ore and 78 pounds heavier than his estimate for the Iron Sandstone. It will be noted, also, that Grimsley's estimate of the mining depth (200 feet) is only four-tenths of that used by Reger in Mineral and Grant Counties. Grimsley states that the total outcrop is "not far from 70 miles", but in making his estimate, he reduced this to 50 miles. An examination of Map IV accompanying this report, shows 3 extensive outcrops of Clinton rocks, one 34 miles long in eastern Hardy, a double exposure on Hanging Rock-Pine Ridge 8½ miles long on each side, or 17 miles total, and a third, 7 miles long, on Elkhorn Mountain, in southwestern Hardy, a total of 58 miles in Hardy County. Map II of Hampshire County shows two extensive areas of Clinton rocks, one 8 miles long in southeastern Hampshire, and the other 17 miles long, in the northeastern part of the county, a total of 25 miles, and a total of 83 miles ni the two counties. On a previous page of this report, Dr. Tilton has made an estimate of the Fossil Ore in Hampshire County, basing his estimates on 2-foot thickness and a weight of 3 tons per cubic yard (which equals 222 pounds per cubic foot), a mining width of 150 yards (450 feet) from the line of outcrops. He made no estimate for the Iron Sandstone stating: "* * There is a sandstone in the Clinton Series that contains a considerable quantity of iron but the percentage of iron is too low and the amount of silica too high to prove of value under any conceivable conditions."

In making an estimate of the total iron ore in Hardy County, Tucker has assumed the following: An outcrop of 58 miles, a thickness of 1 foot for the Fossil Ore Horizon and 10 feet for the Iron Sandstone, with mining width or depth of 500 feet, and a weight of 200 pounds per cubic foot for the Iron Sandstone and 280 pounds for the Fossil Ore Horizon. This gives a total of 15,022,000 short tons for the Fossil Ore Horizon, and a total of 210,308,000 short tons for the Iron

Sandstone, or a total of 225,330,000 short tons for the two horizons, about 3 times as much iron ore as estimated by Grimsley for both eastern Hardy and Hampshire. If the assumed weight of a cubic foot of the ore be estimated at 222 pounds (used by Tilton for Hampshire County), these estimates would be revised to a total of 16,674,420 tons for the Fossil Ore Horizon and 166,744,200 tons for the Iron Sandstone, or a total of 183,418,620 tons for the two horizons, a quantity still approximately 2½ times as great as Grimsley's estimate, which is practically the difference in mining depth assumed, while the length of outcrop has been increased slightly, and the width cut one-third.

In order to make the record complete regarding the Iron Sandstone ore in Hampshire County which Dr. Tilton regards as valueless, the following estimates have been made, based on 8 miles of outcrop in southeastern Hampshire and 17 miles in northeastern Hampshire County: Thickness assumed 10 feet, weight 200 pounds per cubic foot, mining depth 500 feet, 25 miles outcrop: Total ore, 66,000,000 short tons. If the same weight (222 pounds per cubic foot) as used in Dr. Tilton's estimate for the Fossil Ore be used and the other factors remain the same, the total ore would be 73,260,000 short tons.

On pages 252-3, under "Economic Aspects" of the Clinton, will be found Dr. Prouty's views regarding the iron ores in this series. To make the record complete in this chapter, his remarks are here repeated, as follows:

"In the Elkhorn Mountain Anticline area there are several old openings on the Clinton iron ore. These are on the western limb of the fold and some of the openings are over the line in Grant County. The ore in this district is variable in its thickness. The thickest bed of ore measured in any of the old prospect pits is 38 inches. At other localities in this district ore from 3 to 10 inches in thickness is common. It would seem from the above that while there may be locally sufficient ore to encourage development, the variability of the bed and the distance from market make profitable development of these red ores entirely out of the question.

"The Iron Sandstone beds are frequently blocky and the stone is very resistant to weathering, so that its outcrop is frequently a minor ridge. This resistance to weathering, in addition to its red to brown color, gives the sandstone value as a building stone for which purpose it might be utilized, if the deposits occurred close to a large city."

It will be noted that Dr. Prouty makes no reference to the Iron Sandstone as a source of iron in Hardy County. Under "Economic Aspects" of the Oriskany Sandstone on page 299 of this report, Dr. Prouty also makes no reference to the Oriskany iron ores as a source of iron in the county.

The average of 37 analyses of iron ores in Hardy County given in the table from Volume IV of the Survey and reproduced on pages 403-4 of this report, it will be noted, shows that the metallic iron content was 42.79, silica 20.44, manganese dioxide 0.526, phosphorus 0.551, sulphur 0.024, and lime oxide 0.57 per cent. From the allowable limits of "Chemical Impurities" for Bessemer iron ore, pages 414-415 of this report, it will be noted that Iron Ores are classified as Bessemer or non-Bessemer ores on the basis of their phosphorus content. The maximum allowable limit of phosphorus in ordinary steel is 1/10 of one per cent. Phosphorus is usually determined in analysis as phosphoric acid (P_2O_5) and the percentage of phosphoric acid divided by 2.29 (2.2886) will give the percentage of phosphorus. A Bessemer iron ore is one in which the percentage of phosphorus in the pig iron made from it will not exceed 1/10 of one per cent. According to Keep's rule to obtain the maximum limit of phosphorus in a given iron ore, the percentage of iron in the ore (42.79) divided by 1,000, gives 0.04279 per cent. as the maximum limit as calculated from the average analysis of the iron ores of Hardy County. The average analysis, however, shows 0.551 per cent. phosphorus in Hardy County's iron ores. If Nitze's phosphorus ratio be used to determine the limit, 100 divided by 42.79 (per cent. metallic iron in average) equals x divided by 0.551 (per cent. phosphorus in average), it is found that the resulting pig iron from such an ore would contain 0.129 per cent. phosphorus, while 0.10 per cent. represents the allowable limit. Phosphorus, as stated by Grimsley, is one of the most troublesome and injurious impurities in iron ores. Small percentages render the iron brittle when cold, and the ores are known as cold-short. Iron has a very strong affinity for phosphorus, so it can not be separated in the blast-furnace and this element remains in the pig iron. Also, any phosphorus present in the fuel or flux will pass into the pig iron and not into the slag. Considering only the phosphorus content of the Hardy County iron ores, it will be seen from these calculations made on the average analysis of the samples that they would not be suitable for Bessemer ore. The phosphorus content, however, would not interfere with the use of these ores in the Basic Bessemer process or in the Basic Open-Hearth process. In the former the converter is lined with basic material, as calcined limestone or dolomite, which removes the phosphorus from the iron. The same result is accomplished in the latter process. According to Wedding, the amount of phosphorus in the pig iron used to the best advantage in these basic processes should not exceed 3 per cent. Usually pig iron with 2 to 2.5 per cent. phosphorus is used;

but with as low percentage as 1.2, no results are reached. However, the pig iron in these basic processes should be low in silica, not over 1.5 per cent., and not over 0.12 per cent. sulphur, and 2.2 to 3 per cent. metallic manganese.

The average percentage of sulphur as shown by the 37 analyses of Hardy County iron ores (0.024) is below the limit (1/10 of one per cent.) for common steel, and still below the limit for steel rails (0.08 per cent.) Sulphur renders the iron red-short or hot-short; that is, brittle when hot. Manganese when present tends to neutralize the sulphur. Sulphur has a tendency to combine with the slag and so is partially removed in the blast-furnace. Manganese also forms a more fluid slag, causing the iron to be more completely separated from its impurities in the blast-furnace.

The maximum allowable limit of manganese in steel rails is 0.7 to 1.00 per cent., while in structural steel a higher limit may be used. According to Campbell, quoted by Grimsley, "As the percentage of manganese is increased over 1.5 to 2, the metal becomes brittle and almost worthless, and this remains true with further increase until an alloy is formed with 6 to 7 per cent. manganese, when the metal is very hard and becomes tougher when tempered." It reaches a maximum toughness when 14 per cent. of manganese is present, further additions causing a sudden decrease in ductility, and over 20 per cent. bringing a rapid decrease in breaking load. The percentage of manganese shown by the average analysis of Hardy County iron ores is low enough for ordinary steel and steel rails, while the percentage would be too low for the harder alloys, car wheels, etc.

The main impurity of the Hardy County ores appears to be silica, the average analysis showing 20.44 per cent. Silicon, according to Keep, will alloy with iron up to 10 per cent. and by special treatment up to 20 and 30 per cent. In small quantity, silicon appears to have little effect on the ductility or toughness of steel, though some experiments show an increase of 80 pounds to every 0.01 per cent. silicon up to 4 per cent.

and beyond this a decline. Structural steel usually runs 0.03 to 0.05 per cent. silicon, while in the best grades of tool steel it runs 0.20 to 0.80. Silicon makes the metal both hot- and cold-short, but its effect depends on the relative proportion of carbon. With carbon reaching 0.10 per cent., silicon might be 0.5 or more and not cause the metal to be brittle, while if the carbon was 0.5 per cent., the same amount of silicon would cause the metal to be hot- and cold-short. On a preceding page will be found Keep's table quoted by Grimsley giving the allowable percentages of silicon in the various grades of iron.

The presence of aluminum in iron appears to increase its tensile strength. This element was not determined in Grimsley's table of analyses of Hardy County iron ores. In 12 recent tests made for this report, however, the average Al_2O_3 was found to be 8.17 per cent. Aluminum would therefore be 8.17 divided by 1.8856 or multiplied by 0.53033, which gives 4.3328 per cent. According to Campbell, 1 per cent. aluminum increases tensile strength 3,000 to 8,000 pounds per square inch, and decreases ductility.

To calculate the metallic iron content when the analysis gives the percentage of Fe_2O_3, divide the percentage by 1.4298 or multiply the percentage by 0.6994, which will give the percentage of Fe.

From the analyses of the iron ores of Hampshire and Hardy Counties as also from those of adjoining areas in the same rock series, it would appear that while the quantity of ore may be large, its present value is not very great. It may have some value at a remote future date when the purer ores of the Lakes region near exhaustion or when the companies are forced to mine and use ores approaching the Hardy County ores in chemical composition or the blast-furnace practice improves to such an extent that the impure ores may be used without excessive cost. The cost of mining the Hardy County ores would be great except for those areas where the ores form the slopes of the mountains. Their shipment by tram and rail would tend further to increase the cost, in comparison with the water and low-grade rail shipments of the Lake ores to Pittsburgh and other steel-producing centers.

FORESTS.

In 1911 the West Virginia Geological Survey published Volume V by A. B. Brooks on Forestry and Wood Industries of the State. The following items concerning Original Timber Conditions, The Lumber Industry, and the Present Forest Conditions in Hardy County, are taken from pages 156-159 of that volume:

"Original Timber Conditions.

"As a whole, the county was not heavily timbered. The principal valleys and the rich mountain coves, however, once contained a dense stand of oaks, hickories, walnuts, ash, basswood, and many other hardwoods. The timber has been removed from nearly all the bottom lands, but a few remaining virgin woodlots furnish evidence of the superiority of the valley timbers. Up to about 1891 the county contained a considerable quantity of good pine. White oak and chestnut oak were the leading timbers, both growing abundantly, the former in nearly all sections, and the latter on dry ridges and exposed mountain faces. The stand of timber per acre on the remaining virgin tracts varies from about 500 feet to 5,000 feet. A stand of timber far in excess of this once occupied the rich lands that have been cleared for agricultural purposes.

"The original forests of the county, as indicated by the large virgin areas still to be found on some of the mountains and in the farmers' woodlots, were preeminently forests of oak. The 12 species of oaks named below were observed during a 2-hours' drive near Moorefield on September 10th, 1909:

"Red Oak (Quercus rubra); Pin Oak (Quercus palustris); Scarlet Oak (Quercus coccinea); Black Oak (Quercus velutina); Scrub Oak (Quercus nana); Shingle Oak (Quercus imbricaria); White Oak (Quercus alba); Post Oak (Quercus minor); Mossy-cup Oak (Quercus macrocarpa); Swamp White Oak (Quercus platanoides); Chestnut Oak (Quercus prinus); Yellow Oak (Quercus acuminata). Another species, the Black Jack Oak (Quercus marylandica) is reported by Dr. C. F. Millspaugh from the same locality.

"The Lumber Industry.

"The lumber business in this area which, until within the present year had been far removed from railroads and other means of rapid transportation, is not comparable with the enormous industry which exists in many other parts of West Virginia. Naturally, there never have been any large mills in the county, and all the sawing, so far, has been done by the old-fashioned upright water sawmills and by small portable steam mills which were hauled in on wagons and by traction engines. The first steam sawmill was brought in by F. B. Welton and placed just below the Petersburg Gap in the southwest end of the county. About a dozen sawmills are now in operation.

"The cross-tie industry has taken out, it is said, about 70,000 ties a year for the past 10 years. Most of these have been rafted down the South Branch to Romney and shipped from there by rail.

"Much of the good walnut has been hauled out on wagons and exported in the log.

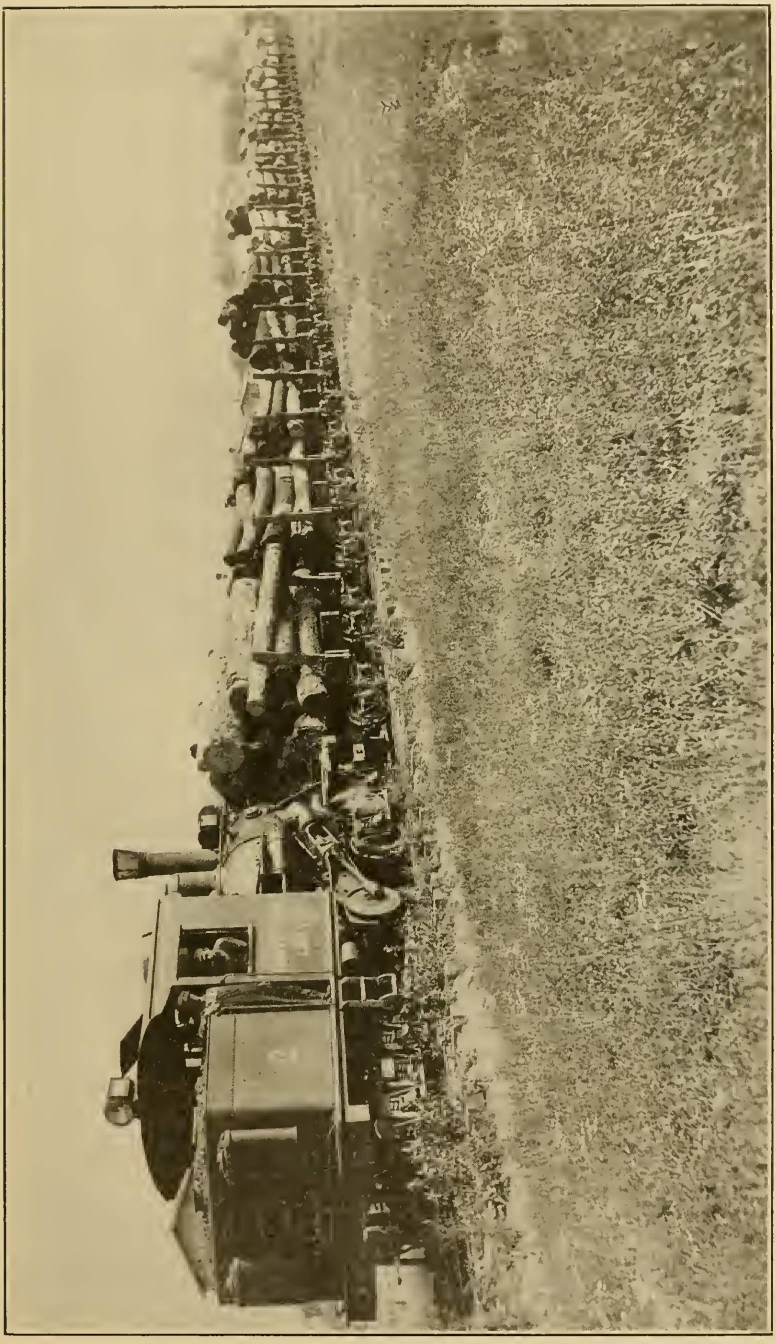

PLATE LXXVII.—Logging train of South Fork Lumber Company.

"On the east side of the county some good pine timber was hauled to Virginia for building purposes several years ago.

"According to Martin's 'Gazetteer of Virginia and the District of Columbia', there were 2 tan yards, 2 wagon makers, and 1 chair maker in Hardy County (then embracing Grant) in 1835. A large quantity of excellent chestnut oak has been wasted at the early tan yards and the larger tanneries of more recent years. According to Mr. C. B. Welton, of Moorefield, the trunks of the thousands of chestnut oak trees that were peeled in the early days and up to about 5 years ago by the owners of the larger tanneries in Virginia and at Lost City and Moorefield, were left on the ground to decay.

"Shingles and locust posts were often traded to merchants for goods during the period of early settlement.

"The Present Forest Conditions.

"Hardy County still contains about 64,000 acres of virgin woodland. This lies principally on both sides of the South Fork of the Potomac in the southeast and in scattered boundaries of various sizes along the principal mountains, as seen from the map which accompanies this report. Outside of this there is a large acreage of inferior woodland upon the low, sandy ridges lying back from the river bottoms. On these areas are to be found a more or less dense stand of scrub pine, 'jack' oak, and others of little commercial value. There are many small areas from which the best timber has been taken, but these are owned by farmers and hence are not classed as cut-over land.

"In some localities where the mature pine timber was killed by insects about 18 years ago, there is a slight reproduction of softwoods, such as yellow pine, white pine, pitch pine, scrub pine, and table mountain pine, and in many places an excellent stand of young locusts, oaks, chestnuts, ashes, poplars, and others.

"Perhaps not more than 25 per cent. of the whole county is cleared for cultivation and grazing purposes. Moorefield District, including the best of the South Branch Valley, is the most improved section; and South Fork District, embracing much of the mountain woodland on the southeast, is the roughest and least improved."

Present Forest Conditions.

The topographic map accompanying this report on Hardy County is made up from portions of the Greenland Gap, Moorefield, Wardensville, Petersburg, Orkney Springs, and Edinburg Quadrangles. The United States Geological Survey publishes these sheets in two forms, one plain, and the other with green overprint showing all the timbered areas of the county, both virgin and woodlot. Anyone desiring information about any particular section of the county with reference to timber conditions will find the forest maps of great value. The quadrangles cost 10 cents (currency, not stamps) each and may be procured by writing The Director, United States Geological Survey, Washington, D. C.

Shenandoah National Forest.

The United States Government has within recent years taken over much of the cut-over forest lands in Hardy County lying along the Virginia State line and has established the Shenandoah National Forest. Large acreages have also been procured in Pendleton County, West Virginia, and Shenandoah and Rockingham Counties, Virginia, adjoining on the east, for inclusion in this National Forest, which it is proposed eventually to be included in the Shenandoah National Park under consideration of formation at this time by the Government and the States of Virginia and West Virginia. The Government has built and improved many roads through the Hardy County area included in the National Forest besides building paths, trails, lookout towers, etc. As mentioned under Bark Industry, the Government is also disposing of most of its chestnut trees and chestnut bark in order to prevent the spread of the "blight" which has hit a portion of the forest in recent years. It is probable that additional acreage will be added from time to time as the Government comes to terms with the original owners of cut-over lands adjacent to the present boundaries of the National Forest.

Forest Protection Service.

On the Shenandoah National Forest an efficient patrol system is in effect. Private areas of woodland have been protected in recent years by the Central West Virginia Fire Protective Association, a semiofficial organization, supported in part by State and Government funds but mainly by private assessment based on acreage. A lookout tower is maintained about a mile east of Sugar Knob in the southeastern part of the county on the Virginia State line.

Bark Industry.

The bark from a great number of chestnut trees has been stripped and used in the tanneries of the county and also shipped to others near by. As mentioned elsewhere, a great quantity of timber was left to rot on the ground after stripping the bark therefrom, but a degree of conservation seems to be in effect at this time and the previous waste along this line is being eliminated as much as possible. In recent years, the "blight" has struck the chestnut trees in the eastern part of the county along the Virginia line, where is located the main portion of the Shenandoah National Forest. The Government has been making strenuous efforts to sell its bark from these blighted trees and has been cutting the trees to prevent the spread of the disease. The Union Tanning Company is the largest user of bark in the area under discussion. Its plants in Hardy County are described elsewhere in this report.

Reforestation.

The topography of Hardy County is so rough in places that it would seem probable that some Government or State policy of keeping the mountain sides and ridges of a considerable part of the county in perpetual forest would be advisable, confining agriculture to the valleys and lower portions of the uplands, as the eventual return from the land under such a system would be greater than if it were cleared and farmed.

Many of the high slopes and ridges of the county have been planted to fruit trees, peaches and apples predominating, on the chert lands near the contact of the Oriskany Sandstone and Helderberg Limestone. The New Scotland Chert has a peculiar economic interest because of the discovery in recent years that fruit trees of almost every description flourish on its outcrop, even in localities where there is seemingly scarcely enough soil for tree growth. Early frosts may, of course, kill some of the fruit on very high mountains, but this species of reforestation would be even more profitable, where these chert lands occur, than reforesting with timber trees, since the returns would begin to come in in less than one-third of the time required for forest tree growth, and would be an annual affair thereafter.

Native Trees, Hardy County.

The following list of trees native to Hardy County has been compiled from Chapter VIII, The Native Trees of West Virginia, of Volume V, West Virginia Geological Survey, prepared by A. B. Brooks and published in 1911. The list probably does not include all the native trees of the county, but gives the names of only such species as have been definitely determined, and mentions the localities, in most instances, where it is certain they are to be found.

Pinus strobus, L. White Pine.
Hardy: Scattered growth.
Wood.—Soft, straight-grained, easily worked, light, not strong.
Uses.—Valuable wood for interior finish, for fixtures, shelving, cupboards, etc. Used frequently for shingles, for boxes, barrels, and tanks, for numerous cabinet shop articles, and for excelsior and pat-

tern making. Much of the white pine growing in the counties back from the Ohio River was cut for ship timber.

Pinus rigida, Mill. Pitch Pine. "Bull Pine". Rosin-tree".

Found locally on dry hills in Hardy County.

Wood.—Coarse-grained, brittle, light, reddish, very durable. Resin-filled knots are frequently found in deciduous woods which have been exposed to the weather for hundreds of years.

Uses.—Wood excellent for fuel. Used also for charcoal, interior finish for houses, for furniture, for bridge timber, boxes, and crates. Tar is often made from this wood. An area on Snaggy Mountain, near Terra Alta, Preston County, was used for this purpose. Not an important timber tree in West Virginia.

Pinus echinata, Mill. Yellow Pine. Short-leaved Pine.

Hardy: Scattered growth.

Wood.—Hard, heavy, coarse-grained, yellowish.

Uses.—A valuable timber tree, now nearly exhausted. Wood used for house finish, boxes, crates, and barrels, farming implements, and furniture.

Pinus virginiana, Mill. Jersey Pine. Scrub Pine.

Hardy: Common on sandy hills.

Wood.—Soft, light, brittle, coarse-grained, decays slowly when placed in contact with soil.

Uses.—Of little value as a timber tree. Wood used for boxes, crates, fencing, ties, and fuel.

Pinus pungens, Michx. Table Mountain Pine. Hickory Pine.

Found scattered sparingly with other kinds of softwoods in Hardy County.

Wood.—Coarse-grained, brittle, light.

Uses.—Not valuable for lumber, used for fuel and charcoal.

Thuya occidentalis, L. White Cedar. Arbor-vitae.

Rare. Collected on the North Fork of South Branch of Potomac between Circleville and Mouth of Seneca in Pendleton County. Said to grow also on South Branch and on the South Fork of the Potomac.

Wood.—Soft, brittle, light, very durable.

Uses.—Valuable for posts, ties, poles, etc., but too rare in West Virginia to be of great commercial or domestic value.

Juglans cinera, L. Butternut. "White Walnut".

A common tree. Found throughout the State except on highest mountains. Thrives at higher altitudes than Black Walnut, reaching 3,000 feet, or over, in its distribution along cold mountain streams in Randolph and adjacent counties.

Wood.—Light, soft, coarse-grained, light-brown, durable.

Uses.—Less valuable than black walnut. Wood used for interior finish for houses, for posts, etc. Bears edible nuts.

Juglans nigra, L. Black Walnut.

Still found in scattered growth in rich coves, valleys, and hillsides in every county. Not found at high altitudes.

Wood.—Heavy, dark brown, hard, coarse-grained, durable heartwood.

Uses.—A very valuable timber tree. Wood used for furniture of all kinds, veneering, musical instruments, wainscot, gun stocks, and for many other purposes. Produces large quantities of edible nuts.

Hicoria minima, Britt. Bitternut. Swamp Hickory.

Infrequent. Found in rather small numbers in Hardy County, near Moorefield.

Wood.—Hard, close-grained, heavy, tough, light brown.

Uses.—Wood used for fuel, handles, hoops, etc. Fruit bitter.

Hicoria ovata, Britt. Shellbark Hickory. Shagbark Hickory.

A common tree. Found in all parts of the State except on high mountains.

Wood.—Heavy, hard, strong, tough, close-grained, flexible, light in color.

Uses.—Very valuable wood. Used for agricultural implements, handles of various kinds, baskets, vehicles, and fuel. Produces delicious nuts.

Hicoria glabra, Britt. Pignut.

A common tree. Grows in every county in the State, but not frequent at high altitudes.

Wood.—Similar to that of other hickories.

Uses.—Same as in the preceding species of hickory.

Salix nigra, Marsh. Black Willow.

An abundant tree along streams throughout the State. Most common in the lower counties but found to some extent in almost every locality.

Wood.—Soft, light, not durable.

Uses.—Of greatest value in West Virginia in preventing the falling in of banks. Wood of little commercial value.

Carpinus caroliniana, Walt. Hornbeam. Blue Beech. "Water Beech".

A small abundant tree, distributed along streams and in moist ground throughout the State.

Wood.—Close-grained, heavy, light-colored.

Uses.—Of no commercial value. Sometimes used for levers, wedges, and other minor domestic purposes.

Ostrya virginiana, K. Koch, Hop Hornbeam. Ironwood.

Dry gravelly slopes and ridges often in the shade of oaks and other large trees. Small tree. Frequent in thinly scattered growth throughout the State.

Wood.—Very hard, close-grained, heavy, durable.

Uses.—Valuable for posts, tool handles, and for various domestic uses. Found in such small quantities as to render it of little importance.

Fagus americana, Sweet. Beech.

Abundant in many parts of the State; found to some extent in every county.

Wood.—Tough, hard, close-grained, light red, not durable in contact with ground.

Uses.—Wood used for furniture, broom handles, clothes pins, and numerous small wooden articles.

By-products: charcoal, wood alcohol, acetate of lime.

Castanea dentata, Borkh. Chestnut.

Frequent throughout the State; most abundant and of largest size through the high hilly and mountainous sections.

Wood.—Soft, light, coarse-grained, not strong, durable in contact with the ground, light brown.

Uses.—Cheap furniture, interior finish, telephone and telegraph poles, fence posts, rails, shingles, boxes, crates, etc.

Valued on account of its nuts.

Quercus rubra, L. Red Oak.

Found throughout the State. Most frequent and of largest size in the high hilly mountainous sections. Grows at higher elevations than the other native oaks.

Wood.—Hard, heavy, medium close-grained, reddish-brown.

Uses.—One of the valuable timber trees. Chief use of wood is for furniture and interior finish for houses.

Quercus palustris, Muench. Pin Oak. Swamp Spanish Oak.

Hardy: Few trees near Moorefield.

Wood.—Heavy, coarse-grained, light-colored.

Uses.—Not important as a timber tree in West Virginia. Wood used for construction, boards, posts, rails, and staves.

Quercus coccinea, Muench. Scarlet Oak. "Pin Oak".

Grows on dry hills throughout the State. Not found in the higher mountains.

Wood.—Hard, heavy, coarse-grained, light brown.

Uses.—Wood used for furniture, interior finish, cross-ties, staves, and fuel.

Quercus velutina, Lam. Black Oak. Yellow-bark Oak.

Distributed generally over the State. Abundant in scrubby growth on hills over the southern half of the State, where it is usually known as "Black Jack".

Wood.—Hard, strong, coarse-grained, reddish-brown.

Uses.—Wood used for interior finish, boards, staves, ties, etc. Of less value as a timber tree than some of the other oaks.

Quercus nana, Sarg. Bear Oak. Scrub Oak. "Jack Oak".

Found frequently in Hardy County.

Uses.—Of no commercial value; used occasionally for domestic purposes.

Quercus imbricaria, Michx. Shingle Oak. Laurel Oak.

Infrequent. Found growing along streams. Few trees near Moorefield on South Branch of Potomac.

Wood.—Hard, heavy, coarse-grained, light brown.

Uses.—Not valuable as a timber tree in West Virginia. Wood used for interior finish, furniture, boards, and fuel.

Quercus alba, L. White Oak.

Sandy plains and gravelly ridges, rich uplands, intervales, and moist bottom-lands, sometimes forming nearly pure forests. One of the most widely distributed timber trees of the State. Found in every county and in almost every wooded locality except those of the highest elevations.

Wood.—Hard, close-grained, heavy, light-colored, durable.

Uses.—Very valuable. Wood used for furniture, interior finish, staves, boards, cross-ties, vehicles, ship-building, and for many other purposes.

Quercus minor, Sarg. Post Oak. Iron Oak.

Not abundant in any locality nor widely distributed in the State. Common near Moorefield, Hardy County.

Wood.—Heavy, hard, close-grained, durable.

Uses.—Valuable for posts, interior finish of houses, furniture, boards, cross-ties, staves, and vehicles.

Quercus macrocarpa, Michx. Burr Oak. Mossy Cup Oak.

Rare in West Virginia. One tree near head of Mudlick Run along Romney and Moorefield turnpike, in Hardy County.

Uses.—A valuable timber tree in some States, but too rare in West Virginia to be of any commercial importance. Wood used for same purposes as that of white oak.

Quercus platanoides, Sudw. Swamp White Oak.

Borders of streams and swamps in moist fertile soil. Infrequent in West Virginia. In Hardy County, scattered along the South Branch near Moorefield.

Wood.—Heavy, hard, tough, light brown.

Uses.—Valuable for interior finish, boat-building, cross-ties, staves, fencing, and fuel.

Quercus prinus, L. Chestnut Oak. Rock Chestnut Oak.

Hillsides and high rocky banks of streams in rich and deep or sometimes sterile soil. Common in all parts of the State except on the high mountains and plateaus. Abundant on the dry ridges of Hardy County.

Wood.—Heavy, hard, close-grained, light brown, durable.

Uses.—Valuable for cross-ties, interior finish, fencing, fuel, staves, etc. Bark used extensively for tanning leather

Quercus acuminata, Sarg. Yellow Oak.

Infrequent in West Virginia. Few trees on Mudlick Run, Hardy County.

Wood.—Very strong, heavy, durable, close-grained, light-colored.

Uses.—Fencing, vehicles, staves, interior finish, and cross-ties. Too rare in West Virginia to be of commercial importance.

Ulmus americana, L. White Elm.

Common in most parts of the State. Confined to low land.

Wood.—Heavy, strong, tough, medium coarse-grained, light brown.

Uses.—Valuable chiefly for wagon hubs, boat-building, cooperage, boxes, and furniture. Planted extensively as a shade tree.

Celtis occidentalis, L. Hackberry. Sugarberry. "Hoop Ash".

Hardy: Common at Moorefield.

Wood.—Soft, coarse-grained, not strong, light yellow.

Uses.—Fencing, cheap furniture, agricultural implements, cooperage, boxes, and rough construction.

Morus rubra, L. Red Mulberry.

Frequent throughout the State; found in scattered growth in every county, but nowhere abundant.

Wood.—Light, soft, medium close-grained, very durable, light orange.

Uses.—Especially valuable for fence posts. Used sometimes for handles, cooperage, and agricultural implements. Often left standing or planted for shade and for the edible berries.

Magnolia acuminata, L. Cucumber-tree. Mountain Magnolia.

Low mountain slopes and rocky banks of streams. Scattered among other hard woods throughout the State. Most plentiful in the narrow rich valleys and slopes of the mountainous and high hilly sections.

Wood.—Light, soft, durable, light yellow.

Uses.—Valuable wood for interior finish, kitchen furniture, shelving, pumps, and pulp.

Liriodendron tulipifera, L. Yellow Poplar. Tulip-tree.

A common timber tree in nearly all parts of the State. Most plentiful and largest on the waters of Great Kanawha and southward. Least abundant in Pendleton and other counties drained by the Potomac waters.

Wood.—Soft, light, easily worked, not strong, durable heartwood, light yellow.

Uses.—A very valuable tree. Wood used for building purposes, furniture, veneer, shingles, fencing, pulp, and for many other purposes.

Asimina triloba, Dunal. Pawpaw.

Deep rich moist soil. Common. Scattered groves throughout the State. Rather infrequent in the mountainous counties and absent from the spruce belt, and adjacent highlands.

Wood.—Soft, light, weak, coarse-grained, light yellow.

Uses.—Of little value for its wood. Groves of trees often preserved for the luscious and wholesome fruit.

Sassafras sassafras, Karst. Sassafras.

Abundant in West Virginia, usually on thin dry land. Distributed throughout the State except at high altitudes.

Wood.—Soft, brittle, coarse-grained, durable, dull yellow.

Uses.—Not valuable. Occasionally used for minor purposes. Oil of sassafras distilled from bark and roots.

Hamamelis virginiana, L. Witch Hazel.

Small abundant tree, found throughout the State.

Wood.—Heavy, very hard, close-grained.

Uses.—Infrequently used for any purpose in West Virginia. Bark sometimes used as a medicine.

Platanus occidentalis, L. Sycamore. Buttonwood.

Common throughout the State along nearly all streams below 3,000 feet elevation.

Wood.—Hard, close-grained, light-colored.

Uses.—Now considered valuable. Wood used for interior finish, butcher blocks, furniture, tobacco boxes, etc.

Malus coronaria, Mill. Crab Apple. Fragrant Crab.

A common tree in most sections. Abundant through the high hilly regions in the central and northern parts of the State.

Uses.—The hard, close-grained wood sometimes used for tool handles, mallets, etc. Tree prized for its fragrant blossoms.

Amelanchier canadensis, T. & G. Shad Bush. Service Berry.

Frequent throughout the State. Most plentiful in damp rich soils in the mountainous and high hilly sections.

Wood.—Heavy, very hard, close-grained, brownish.

Uses.—Wood occasionally used for tool handles and other small articles. Tree prized for its edible berries.

Crataegus crus-galli, L. Cookspur Thorn.

Usually on the slopes of low hills in rich soils. One of the commonest hawthorns. Found in abundance in Hardy County.

Prunus americana, Marsh. Wild Plum.

Borders of streams and glades. Thinly scattered over the State.

Wood.—Heavy, close-grained, dark.

Uses.—Wood very rarely used. Fruit often eaten raw or cooked.

Prunus pennsylvanica, L. Wild Red Cherry. "Bird Cherry". "Fire Cherry."

Frequent in burnt lands at high elevations. Less common in lower ground.

Wood.—Light, soft, close-grained, not durable.

Uses.—Wood of little value. Profitable as a covering for burnt lands.

Prunus serotina, Ehrh. Wild Black Cherry.

A common timber tree in the mountains.

Wood.—Light, strong, hard, close-grained, reddish.

Uses.—Valuable for interior finish and furniture.

Cercis canadensis, L. Redbud. Judas-tree.

Common in most parts of the State, forming thickets along borders of fields and banks of streams.

Wood.—Heavy, hard, weak, close-grained, reddish.

Uses.—Seldom used for any purpose.

Gleditsia triacanthos, L. Honey Locust.

Rather infrequent, along streams on both side of the Alleghenies. Found on the South Branch of Potomac near Romney, Hampshire County.

Wood.—Hard, strong, coarse-grained, reddish, very durable.

Uses.—Valuable for posts, cross-ties, hubs, spokes, and fuel.

Robinia pseudacacia, L. Locust. Acacia. Yellow Locust.

Most abundant and of its largest s ze on the western slopes of the Alleghenies of West Virginia; often spreading by underground stems into broad thickets of small and often stunted trees. Widely distributed in West Virginia. Frequent in every county, growing from the lowest elevations up to 3,500 feet and over.

Wood.—Heavy, very hard, strong, durable. brownish with pale yellow sapwood.

Uses.—Very valuable for fence posts, ties, buggy hubs, pins, and bridge and ship timbers.

The locust must be looked upon as an exceedingly valuable tree in West Virginia. It springs up in burnt lands, and cut-over areas, and in almost every locality where room is made for it to grow it thrives regardless of soils or exposures. Like other legumes it enriches the soil by adding nitrogen wherever it stands and it is a rapid grower, reaching a merchantable size within 25 years or less.

Rhus hirta, Sudw. Staghorn Sumac.

Usually on uplands in good soil, or less commonly on sterile gravelly banks and on the borders of streams and swamps.

A small tree. Common throughout the State, and reaching higher altitudes than the smaller shrubby species of this genus.

Acer saccharum, Marsh. Sugar Maple. Rock Maple.

Found in every county. Superior on the elevated flats and in the rich coves along the Alleghenies from Tucker to Greenbrier and Monroe Counties. Abundant in the high hilly sections just west of the mountains.

Wood.—Strong, hard, heavy, close-grained, reddish.

Uses.—Valuable for interior finish and furniture. This is the prinpal tree from which sap is taken for sugar making.

PLATE LXXVIII.—Panoramic view of South Fork Lumber Company yard at Moorefield. (Right-hand edge of upper view fits left-hand edge of lower view).

Acer saccharinum, L. Silver Maple. Soft Maple.

Closely confined to the borders of the larger streams at low elevations. Found on the South Branch of Potomac from a point between Moorefield and Petersburg to its mouth near Green Spring Station.

Wood.—Hard, rather brittle, easily worked, close-grained, brownish.

Uses.—Wood used for flooring, boxes, crates, and for numerous small household articles. Tree often planted for shade and ornament.

Acer rubrum, L. Red Maple. Scarlet Maple.

Borders of streams, low wet swamps, and rarely on hillsides. Occurs in all parts of the State. Not frequent in the counties east of the Allegheny Mountains.

Wood.—Medium heavy, close-grained, soft, light brown

Uses.—Furniture, chairs, gun stocks, woodenware.

Tilia americana, L. Linden. Basswood.

Found at Cranberry Glades, Pocahontas County. Probably occurs with the following species, but less frequently, in many parts of the State.

Wood.—Light, soft, light brown.

Uses.—Woodenware, pulpwood, cheap furniture, excelsior, etc.

Tilia heterophylla, Vent. Linden. Bee-tree.

Rich wooded slopes in moist soil or near the banks of streams; often on limestone. A common tree in Hardy County.

Uses.—Wood similar to and used for the same as that of the preceding species.

Nyssa sylvatica, Marsh. Tupelo. Pepperidge. "Black Gum."

A common tree throughout the State. Least frequent in the high mountains and in the counties east of the Alleghenies.

Wood.—Heavy, tough, medium coarse-grained, light yellow.

Uses.—Wood used for wheel hubs, ladders, mallets, wagon beds, piles, and rough flooring.

Cornus florida, L. Flowering Dogwood.

Usually under the shade of taller trees in rich well-drained soil. Frequent in all parts of the State.

Wood.—Heavy, close-grained, hard, brownish.

Uses.—Valuable for domestic purposes. Used for gluts, levers, handles, etc.

Cornus alternifolia, L. Alternate-leaved Dogwood.

Rich woodlands, the margins of the forest, and on the borders of streams and swamps, in moist well-drained soil. Found along the Allegheny Mountains and westward throughout the State. Infrequent on the east.

Uses.—Used only occasionally for minor domestic purposes.

Oxydendrum arboreum, DC. Sorrel-tree. Sour wood. "Sour Gum".

Well-drained gravelly soil on ridges rising above the banks of streams. A small tree found frequently in all sections west of the Allegheny Mountains. Rare in the eastern counties.

Uses.—The hard, heavy, close-grained wood is sometimes used for handles, bean poles, and for other minor domestic purposes.

Diospyros virginiana, L. Persimmon.

Frequent on low lands throughout the State. Probably most abundant in the valleys of the several larger tributaries of the Potomac.

Uses.—The heavy, strong, dark wood infrequently used. Manufactured in some States into plane stocks, shoe lasts, and other small articles. Fruit edible in late fall and winter.

Fraxinus americana, L. White Ash.

Common in rich rather moist soil on low hills, and in the neighborhood of streams. Found throughout the State.

Wood.—Heavy, strong, close-grained, light-colored.

Uses.—A valuable wood for interior finish, furniture, agricultural machinery, handles, vehicles, etc.

Viburnum prunifolium, L. Black Haw. Stag Bush.

Dry rocky hillsides and fence-rows and the sides of roads. A common small tree.

Sawmills.

On page 447 of Volume V of the Survey, Mr. Brooks lists the following as operating circular saws in Hampshire and Hardy Counties in 1911:

Hampshire County.

James A. Hannas, Three Churches.
C. E. Wolford, Augusta.
Stephen Hannas, Shanks.
I. N. Baker & Co., Romney.
T. F. Martin, Romney.
Alex. Everett, Romney.
W. J. Powell, Romney.
James F. Smith, Hoy.

Hardy County.

Wm. Conrad, Wardensville.
R. C. Anderson, Wardensville.
H. D. Reed, McCauley.
James Teets, Baker.
George Grady, Lost River.
B. H. Cullers, Mathias.
Roy Welton, Moorefield.
J. H. Rogers, Moorefield.
Milton Vetter, Moorefield.

Polk's West Virginia Gazetteer for 1923-24 lists the following lumber manufactories in Hampshire and Hardy Counties:

Augusta	S. W. Shank.
Baker	Henry Link.
Bloomery	R. C. Peacemaker
Capon Bridge	J. P. Ramsbuy.
Great Cacapon	P. T. Nolan.
Green Spring	Garette Messick.
Hanging Rock	John Reuse.
Inkerman	T. F. & Samuel Constable.
Lost River	P. D. DeLawder & Co.
Lost River	James Teets.
Moorefield	South Fork Lumber Co.
North River Mills	John Moreland.
North River Mills	Edgar Smith.
Romney	So. Branch Tie & Lumber Co.
Wardensville	Harry Barb.
Wardensville	J. D. Barney.
Wardensville	Nathan Conrad.
Wardensville	H. H. Casteel.
Wardensville	Dellinger Bros.
Wardensville	Ely & Bradford.
Wardensville	Fitzwater & Kohn.
Wardensville	Funkhouser Bros.
Wardensville	A. H. Hottle.
Wardensville	W. L. Murnaw.
Wardensville	Stewart & Pugh.
Wardensville	G. J. Wilson.
Yellow Springs	Carson Davis.
Yellow Springs	C. B. Davis.

WATER-POWER RESOURCES.

The three following tables showing the indicated horsepower developed by South Branch of Potomac River and its tributaries and by the minor tributaries of North Branch of Potomac River having bearing on the area covered by this Report are taken from pages 434-436 of Callahan's Semi-Centennial History of West Virginia, published in 1913, and are part of a special article on "Water-Power Resources of West Virginia" prepared by A. H. Horton, District Engineer, Water Resources Branch, United States Geological Survey.

The following remarks concerning the Potomac River are taken from pages 431-432 of the History above mentioned:

"Potomac River.

"The North Branch of Potomac River rises in the Allegheny Mountains near the southwest corner of Maryland, from there it flows in a northeasterly direction to Cumberland, Maryland; about 15 miles below Cumberland it is joined by the South Branch of Potomac River, forming the head of Potomac River. From Cumberland, the river flows in an easterly direction to Williamsport, Maryland, from which point it flows in a southeasterly direction into Chesapeake Bay. Throughout its entire length the North Branch of Potomac River and the Potomac River as far as the mouth of the Shenandoah River at

Harpers Ferry form the boundary line between West Virginia and Maryland. The mouth of the Shenandoah is at the easternmost point of West Virginia.

"The drainage area of the Potomac River is about 14,500 square miles, of which 3,480 square miles, or 24 per cent., are in West Virginia.

"The most important tributaries of the North Branch and the main stream in West Virginia are Patterson Creek, Little Cacapon River, Cacapon River, Back Creek, Opequon Creek, and Shenandoah River; only the lower 19 miles of the Shenandoah are in West Virginia. The more important tributaries of the South Branch of Potomac River are North Fork of South Branch of Potomac River, Lunice Creek, and Moorefield River.

"The North Branch and the South Branch with their tributaries and the tributaries of the main stream as far down as the Shenandoah drain a series of narrow and generally fertile valleys lying between parallel ranges which make up the system of the Alleghenies in this region. Their slopes are not, as a rule, very great. The slopes of the drainage basins, however, are generally very steep. There are few lowlands to be overflowed and no lakes whatever in the region, consequently these streams and the Potomac River are subject to sudden and very heavy freshets in wet seasons, and in dry seasons their discharge becomes small. From the junction of the North Branch and South Branch the Potomac cuts through the mountains at nearly right angles. Its valley is narrow, its slope in many places great. The bed is generally gravel and boulders with ledge rock at little depth or appearing at the surface.

"The elevation of the sources of the North Branch and South Branch is about 3,500 and 3,000 feet, respectively. The average fall of the North Branch from Stony River to the mouth is 23 feet per mile; the average fall of the South Branch from Thorn Run to the mouth is about 12 feet per mile. The average fall of the Potomac River to Harpers Ferry is 2.5 feet per mile.

"About one-third of the entire basin is forested, the heaviest growth being located in the region of roughest topography generally near the headwaters of the southern tributaries. The average rainfall at the sources is about 40 inches.

"The following railroads are in the basin: The Baltimore and Ohio Railroad parallels the river from Piedmont to Berkeley County, the Western Maryland from Williamsport to the sources of the North Branch. The Norfolk and Western Railroad crosses at Shepherdstown, the Cumberland Valley Railroad near Williamsport, the Baltimore and Ohio goes up the South Branch to Romney (now to Petersburg), paralleling the river part of the way. The Chesapeake and Ohio Canal follows the river from Cumberland to Georgetown, D. C.

"The Allegheny-Kanawha coal formation occurs in the basin of the North Branch from the sources to Piedmont.

"As a water-power stream the principal disadvantage of the Potomac is the great variability of its flow; this, however, could be remedied by means of reservoirs. Good rock foundations for dams can generally be found at small depth; and the banks are, as a rule, favorable, and there are several sites where large falls could be rendered available. Table No. 21 gives the indicated horse-power on the North Branch of Potomac River and Potomac River (we have omitted this table since it is outside the area of this report), and No. 24 that on the minor tributaries. Tables Nos. 22 and 23, respectively, give the horse-power on the South Branch and on the tributaries of the South Branch. Only those tributaries located wholly or in part in West Virginia have been considered."

"Table No. 22.—Indicated Horse-power Developed by South Branch Potomac River.

Section of River: From	Section of River: To	Length. Miles.	Mean Drainage Area. Square Miles.	Minimum Discharge. Second-feet.	Assumed Discharge for Maximum Development. Second-feet.	Total Fall. Feet.	Minimum Horse-power.	Assumed Maximum Development. Horse-power.	Horse-power available from storage for 12 mos.	6 mos.	3 mos.
Source	Above Thorn Run	25	a103	13.4	46	1,700	524	1,800	------	------	------
Below Thorn Run	Above North Fork South Branch Potomac River	35	236	30.7	107	810	2,280	7,970	10,600	21,200	42,400
Below North Fork South Branch Potomac River	Romney	40½	1,025	131	459	b323	3,890	13,600	6,000	12,000	24,000
Romney	Mouth	29½	1,450	189	653	127	2,210	7,630			
Totals		130				2,960	8,904	31,000	16,600	33,200	66,400

a. Total area.
b. Fall reduced to 223 feet by proposed reservoir.

"Table No. 23.—Indicated Horse-power Developed by Tributaries of South Branch Potomac River.

STREAM	SECTION From	SECTION To	Length. Miles.	Total Drainage Area. Square Miles.	Minimum Discharge. Second-feet.	Assumed Discharge for Maximum Development. Second-feet.	Total Fall. Feet.	Minimum Horse-power.	Assumed Maximum Development. Horse-power.
Thorn Run	Source	South Branch Potomac River	15	50	6.5	22	1,500	224	775
North Fork South Branch Potomac River	do	Above Big Run	20	63	8.2	28	1.750	330	1,140
do	Below Big Run	Above Seneca Creek	16	a140	18.2	63	700	1,170	4,060
do	Below Seneca Creek	South Branch Potomac River	18	a280	36.4	126	550	1,840	6,380
Seneca Creek	Source	North Fork South Branch Potomac River	20	61	7.9	27	2,500	454	1,570
Lunice Creek	do	South Branch Potomac River	20	92	12.0	41	2,000	551	1,900
North & South Mill Creeks	do	do	25	100	13.0	45	2,000	597	2,060
Moorefield River	do	Below Little Fork	17	73	9.5	33	1,200	262	905
do	Below Little Fork	South Branch Potomac River	44½	a186	24.2	84	970	2,160	7,500
Mill Creek	Source	do	15	52	6.8	23	800	125	430
Totals								7,713	26,720

a. Total area.

"Table No. 24.—Indicated Horse-power Developed by Minor Tributaries of North Branch Potomac River —Potomac River.

STREAM	SECTION		Length. Miles.	Mean Drainage Area. Square Miles.	Minimum Discharge. Second-feet.	Assumed Discharge for Maximum Development. Second-feet.	Total Fall. Feet.	Minimum Horse-power.	Assumed Maximum Deevlopment. Horse-power.
	From	To							
Stony River	Source	Potomac River	27	a59	5.9	35	1,900	258	1,530
Abrams Creek	do	do	19	a37	3.7	22	1,650	141	835
New Creek	do	do	18	a56	5.6	33	1,250	161	948
Patterson Creek	Source	Above Mill Creek	25	a130	16.9	59	1,700	660	2,310
do	Below Mill Creek	Potomac River	21½	217	28.2	98	290	752	2,610
Little Cacapon River	Source	3 miles below Frenchburg	12	a44	5.7	20	1,000	131	455
do	3 miles below Frenchburg	Potomac River	16	80	10.4	36	500	478	1,660
Lost River	Source	Below Kimsey Run	20	a105	15.8	43	1,100	400	1,090
Lost & Cacapon Rivers	Below Kimsey Run	Above North River	48	255	38.3	105	800	2,820	7,740
Cacapon River	Below North River	Potomac River	29	640	96	262	200	1,770	4,820
Trout Run	Source	Cacapon River	17	a45	6.8	18	1,400	219	595
North River	Source	2 miles below Rio	18	a81	12.2	33	1,400	393	1.060
do	2 miles below Rio	Cacapon River	27	143	21.5	59	540	1.070	2,930
Sleepy Creek	Source	Potomac River	34	a120	18.0	49	630	261	710
Back Creek	Virginia State Line	do	28	236	35.4	97	160	521	1,430
Opequon Creek	do	do	29	228	34.2	94	100	315	865
Shenandoah River	do	do	19	2,930	704	1,495	106	6,860	14,600
Totals								17,210	46,188

a. Total area.

MINERAL WATERS.

In Hardy County, only one attempt, so far as known, has been made to commercialize the mineral springs of the county. Many years ago a hotel and several cottages were built at Howards Lick Spring, about 5 miles southwest of Lost City, but fire destroyed many of the buildings some years ago and they have never been rebuilt. The spring-house pavilion and bowling alleys are about all that remain of the formerly much visited spring. It is now owned by H. S. Carr of Moorefield. The assessment for 1923 showed 432 acres assessed at $2.00 per acre, 493 acres at $5.00 per acre, and improvements valued at $435.00, a total of $3,765.00. No analysis of the water is available.

Several springs scattered over the county issue from the Helderberg and Bossardville Limestones.

Little is known concerning the underground mineral waters of Hardy County. It is possible, though hardly probable, that a source of brine would be in the Salina beds (Bloomsburg member) since the Salina in New York State contains great quantities of rock salt and salty brines containing valuable medicinal salts of different kinds. Generally considered, however, Hardy County does not appear to have indications of mineral waters of much value such as are common in some of the southern counties of the State.

Mr. P. F. Sions, of Moorefield, reported an alum spring along the county road between Old Fields and Reynolds Gap, on the Alex. A. Wilson farm, at an elevation of 810′ B., in Marcellus Shale. Mr. Sions also reports a sulphur spring on the lands of Arthur Wilson about one-half mile north of Reynolds Gap, on Mudlick Run, below house where elevation 899 occurs on Maps III and IV, the elevation of the spring being 915′ B. The latter spring occurs close the contact of the Oriskany and Marcellus. Both springs are small, not much water issuing therefrom, when visited by Price and Tucker.

PRECIOUS METALS.

The experienced geologist or mining engineer after studying the stratigraphic and structural evidence given in this Report would doubtless be convinced that precious metals, like gold, silver, copper, and lead, will not be found in appreciable quantities in Hardy County. In former years considerable prospecting was done by the natives in the hope of finding these metals, but their efforts have been in vain, and further work along that line will no doubt meet with the same fate. A common expression in certain parts of the county is that there must be gold or silver present since the Lord evidently did not give them anything else in some particularly barren region. All the rocks in Hardy County are of sedimentary origin, without any trace of igneous or quartzitic intrusions with which these metals are commonly and almost wholly associated. No dikes or plugs were found and the only quartz is that contained in the pebbles of the conglomeratic sandstones. A dike in Pendleton County to the south was found later in making the survey for that county. On analysis of the dike material, no metal of value was reported by Kaplan. Some traces of ores have been reported from Tucker, Mineral, and Grant Counties to the north and west of the area, but they apparently had no value. Like coal, it would be well to discontinue the search for precious metals in Hardy County, since if any are found they will be only fragments of former mineral lodes in the ancient mountain masses to the east from which the sediments of the county were derived.

CLAY.

No clay industry exists in Hardy County at the present time. There are no brick or tile plants, and so far as known no attempt has ever been made to start them, although there is an abundance of raw material suitable for both purposes. There are a few brick houses throughout the county which have been erected from brick burned in temporary kilns, but since the Baltimore and Ohio Railroad was extended through the county all brick has been imported from other counties in this State and Maryland. The abundance of cheap lumber in the county has no doubt retarded the general use of brick for residential purposes.

Transported Clay.—Along the valleys of South Branch, Moorefield, and Lost Rivers, there are extensive deposits of river clay in many places, of variable thickness, that are well suited for common building brick. With the denudation of the forests of the county and the consequent increasing cost of lumber, brick will no doubt come into more general use as building material. Some of this clay occurs along the flood-plain of the rivers and some of it is in the form of terrace material at higher levels. Under the general head of "Alluvium", all Recent deposits in the county are shown on Map IV in yellow color. In many places, the terrace clays have been removed by erosion. This group of clays (transported) includes those which have been removed from their first place of origin. It includes a great variety of clays which are more widely distributed than the residual clays, and they are more valuable clays from an economic standpoint. In this group are found the clays used for structural materials, and for refractory purposes. This is the important clay group in West Virginia. The clays are impure through the admixture of foreign elements. The West Virginia Geological Survey has divided the transported clays into three groups according to their refractory or fire-proof characters, which depend on the amount of fluxing impurities present. On account of the gradation between the clays in these different groups, it would be difficult to give the percentages of fluxing impurities in them. The three groups are: Refractory Clays, Semi-Refractory Clays, and Non-Refractory Clays, with the latter subdivided into Pottery Clays, Brick and Tile Clays, Gumbo used for paving and other kinds of brick. As there are no coal Ballast Clay, and Slip-Clays.

The **Refractory Clays** have the property of withstanding the effects of high temperature, and are therefore valuable in work where such temperatures are used. They are used for fire brick for furnaces, kilns, fire places, etc., for gas retorts, glass pots. In the latter, the clays must be of highest grade to stand the high temperature and corrosive effects of the molten glass. There are two groups of refractory clays, flint and plastic. The flint clays are very hard, compact, flint-like rocks, breaking with a conchoidal or shelly fracture. Many of them on exposure to the air slake and crumble. They vary in purity from those nearly as pure as kaolin to very impure forms. They are sometimes streaked and mottled with dark shades of color due to organic matter, and again, are very light in color, being almost white. As a rule, they are non-plastic and do not become plastic when weathered or ground. In order to use them in the manufacture of brick, a plastic clay must be added. In many places the plastic clay is found with the flint clay, either above or below. A flint fire clay was used at Piedmont, Mineral County, in the manufacture of fire brick. Plastic fire clay lacks the compact texture of flint clays, and is more open, breaking with irregular fracture. It weathers into a soft sticky clay and is often used for paving and other kinds of brick. As there are no coal seams in Hardy County, the clays usually underlying every normal coal seam in the State are absent. These clays, however, do not always deserve the name of fire clays. They are usually plastic clays and some of the best clays in the State are found in this position, and some are plastic fire clays.

Semi-Refractory Clays.—The clays in this group are not used for fire resistance, but for ware which requires a firm, tough body, with a low water absorption. They are clays which vitrify, which means that under sufficient heat the clay partially melts and the particles are thus brought closer together, with a more or less complete removal of the pore space. A good fire brick is porous, while the vitrified wares, in contrast, are non-porous, or better, the pore space is reduced to a minimum.

In the manufacture of paving brick, clays and shales are used. It was formerly believed that shales were not adapted to this work, but now many of the standard grades of paving brick are made entirely from shale, and many manufacturers claim shale makes a better product. In a number of plants throughout the State it is found that better results are obtained from using a mixture of different shales, or shale and clay. Some of the plants by experimenting on such mixtures have found that while a given shale or clay makes a good paving brick, the mixture gives a better product. In the manufacture of sewer pipe, the clays must have about the same qualities as those used for paving brick. The clay must be plastic and burn to a dense, smooth body. The shrinkage must be low in order to produce a uniform product, and avoid cracking or warping. In the manufacture of roofing tile, the clay must vitrify and form a dense and tough body. It must give a good color and have a low air and fire shrinkage, as the thin plates are apt to warp and destroy the shape of the tile. Stoneware is a partially vitrified product which is burned and glazed before removal from the kiln. The clay for this use must be very plastic in order that it may be easily molded and turned into the various patterns.

Non-Refractory Clays.—In this group are included the common pottery clays, and the clays valuable for structural materials. Many of them are impure clays, with low percentage of kaolin. The highest grade pottery clay is the **ball clay**, which is used for a bond with the pure china clays. This clay represents a kaolin clay removed from its place of origin, and it is a very plastic clay in contrast with the non-plastic kaolin clays. The ball clays used in the potteries of this country come from Florida, New Jersey, Missouri, and from England. In the manufacture of flower pots, low-grade clays are used. They are burned at low temperature, and form a porous body. The clay must be plastic and give a good color. Many of the common brick and tile clays are adapted to this purpose.

Brick and Tile Clays.—The building brick and tile clays are usually impure, more or less sandy clays. The kaolin base is low in amount. The iron present determines the color, and the percentage in this State is usually sufficient to give a red color when burned. As a rule they are not adapted to production of a vitrified body, fusing rapidly at elevated temperatures and so twisting out of shape or running together they would ruin the vitrified ware. These clays are used for products burned at moderate temperatures, fusing in the neighborhood of 1800° F. They vary in amount of plasticity, shrinkage, and porosity. Drain tile are made from common brick clays and should burn to a soft, porous body, capable of absorbing water readily. The **gumbo ballast clays** do not occur in West Virginia, occurring mainly in the States bordering on the Mississippi River. They are fine-grained, very sticky or tenacious when wet, giving a tensile strength of 370 to 410 pounds, or twice that of ordinary clays. They have a high shrinkage, 9 to 12 per cent., and the mass disintegrates under heat, causing the clay to crack into gravel, which makes it valuable for ballast. The **slip clays** are easily fusible clays, which are used to coat or slip stoneware, and thus give a smooth and uniform color to the ware. The fluxing elements range from 14 to 20 per cent. A good slip clay must fuse easily, give a uniform color, and not crack or check. In fusion, the slip clay forms a natural glaze, being burned into the ware. In use the slip clay is mixed with water to form a cream, into which the ware is dipped. So far as known, no slip clays have been used from sources in West Virginia.

The definitions, qualities, and uses of the various clays listed above are taken from Volume III of the Survey by Dr Grimsley. His remarks on "**Prospecting for Clays**" will prove of interest to anyone contemplating prospecting or developing the clays of Hardy County:

"A few suggestions will be given in this section for the information of people over the State, farmers and others, who are interested in the development of clays, but who lack chemical and practical knowledge of the clay industry. * * * Unless the clay is of a very high quality, adapted to fire brick or pottery manufacture, it will not pay to ship the clay very far to a plant, or haul it to a distant railroad point.

"There is not a farm in the State but contains clay, good, bad or indifferent, in deposits of greater or less extent. A very small fraction of these deposits will ever be used, and only the best are worth an investigation. Common building brick, and even paving block clays and shales, are so widely distributed in this State along and close to the lines of railroad or waterways that deposits removed from such transportation lines will be valueless except for a small local trade. In some sections, this local trade is supplied with very inferior brick, made from impure clays, while good deposits in the same area might be used to greater advantage. A little careful prospecting work would there add money to the brick maker and beauty and durability to the buildings of the town.

"At the present time (1905) it will not pay to haul even fire and pottery clays by wagon to a distant railroad point. The price last year for good fire clay placed on the car was one dollar a ton, and it could not be mined and hauled to the railroad in competition with this price.

"Some of the finest clays in this State are to-day unused in Pendleton, Hardy, and other counties, because of the lack of railroad transportation for the clay or the wares made from it. When the railroads penetrate these areas, as they will in time, these clay deposits will have a high value, where to-day they are counted as almost worthless. (Since this Report by Grimsley was written, the Baltimore and Ohio Railroad has been built across the western corner of Hardy County and the Winchester and Western Railroad into the northeastern part of the county as far as Wardensville).

"When a clay deposit is located in a section where it might be utilized, its extent should be determined. This may be done by digging a pit to find its thickness, or by boring with an auger. If of shallow depth, its high quality will not make it worth developing.

"Its area or surface extent may be determined by following the stratum from place to place in ravines where the streams have exposed the rocks and soil, in railroad or wagon-road cuts, in wells, or by digging ditches and trenches. Some judgment is here required to be sure the clay is continuous from one exposure to another, and it should be tested in these places to determine whether the quality is sufficiently uniform.

"The amount of cover or overlying material and its nature, whether hard or soft, is important in determining the value of the clay. Only clays of the highest grade will pay the cost of tunnel or entry mines. Mining of clay is avoided so far as possible on account of the expense and danger involved. In this State it would only pay for high-grade clays. If the cover is very thick, or contains hard rock layers, the expense of removal of this useless material will be too great to permit the working of the clay.

"The relation of the deposit to water conditions should be determined. If it lies in a low valley where the pit would be filled with water in wet weather, or where the natural drainage would collect in the openings, there would be added the expense of pumping, which may be prohibitive for profitable work. On the other hand, there should be a sufficient supply of water present for the uses of the plant. Labor conditions, cost of transportation by water or rail to good markets, supply and cost of fuel, must all be considered.

"There is a more or less popular impression that the valuable materials for brick and tile must be present in the form of clay, so in prospecting, shales, often called soapstone, are neglected. In the early days of the paving brick industry in Ohio, the overlying shales were removed at much expense in one of the prominent paving brick plants, in order to secure the clay below. Later, the shales were experimented on, and proved a better material than the clay. In some States, nearly all the brick and tile are made from shales. In this State shales are used in many of the most successful plants. Not all shales are adapted to this work any more than all clays, but in the prospecting work they should not be overlooked.

"In sampling clay or shale, care should be taken to secure an average lot. If a pit is sunk, samples should be secured from top to bottom, and also from a number of pits removed from each other. The sample lot should represent an average of the tract to be developed. The large quantity thus obtained is then ready to be tested at some brick plant or pottery where it can be made into ware and burned, and the character of the product determined. A brick made from a few pounds of clay taken from some one spot does not establish the character of the clay, though it may give some indication of the value. If the quantity of clay selected in this way is larger than required, it should be thoroughly mixed and divided, then, if necessary, mixed again and divided.

"In looking for clays and shales in this State, it should be remembered that kaolin and china clays have not yet been found in any amount worth developing, and the great probability is they never will be. Local deposits of white bleached clay are sometimes mistaken for these high-grade clays.

"Fire clays for number one brick are rare, and when found in favorable localities deserve careful investigation. The clays under the coal seams are popularly called fire clays, but very often they are far removed from this class. The best fire clays are usually hard and flint-like, and when broken show a shelly fracture. After a few weeks' exposure to air and water they may slake to fine flakes, but not all hard clays are fire clays. Men of experience can not be sure of fire clays until tested. A sample of fire clay sent to the Survey by an experienced man showed, on analysis, 16.74 per cent. of fluxing elements; very few clays in the State would equal this clay in fusibility.

"Pottery clays at the present time are not well developed in West Virginia, but they will yet prove valuable. In some of the deposits of good pottery clays found in the present work, the extent proved on investigation to be too small. A bed of pottery clay near some spring, the area, a few rods, perhaps, in diameter, would not justify the erection of a pottery.

"It must be kept in mind that mere prospecting for clays will not prove their value; chemical analysis is not enough; the clays and shales must be tested physically; they must also be actually worked into finished product to determine their real worth. Without this preliminary prospecting the clays will not be available for such tests. The clay may make a high-class product, but its extent, thickness, amount of cover, surrounding conditions as outlined above, must be determined by careful prospecting.

"It is hoped that this report on West Virginia clays will not only be of interest and value to the present clay companies of the State, but that it will also stimulate interest in this group of the State's natural resources and lead its citizens to search for new deposits. It is hoped that this section on prospecting will influence these persons to study all the conditions surrounding the clay deposits and to secure average lots of clay rather than to send a carelessly selected sample to some Survey or Testing Laboratory.

"A few simple tests will be given to aid in this preliminary prospecting work.

"1. A small lump of clay may be roasted in a blue gas flame, as in a gas stove; if a red or brown color be given to the clay, the percentage of iron is high, probably four per cent. or more. Fire clays are low in iron.

"2. By tasting a bit of the clay, bitter salts, alum, epsom, may be detected, or they may occur as white coatings on the outcrop of the clay in the bank. These salts are apt to form whitewash coats on the finished brick, injuring their appearance. By crushing the clay in the mouth the sand may be detected by the grit against the teeth. A rough determination of the amount of such sand may be made.

"3. A study of the method outlined for plasticity in Chapter III (of Volume III) will show that an approximate idea of plasticity may be obtained by working the moist clay with the fingers. This is a good test for pottery clay, moistening the clay and finding whether it can be worked into a definite shape and retain the form without cracking when dry.

"4. A rough brick of small size can be made and easily dried, and a rough determination be made of its shrinkage. If it shrinks out of shape, cracks, or crumbles when dry, its value is very doubtful. For this test, the clay should be ground, thoroughly tempered with water, and dried slowly.

"5. If carbonates of lime are present, a few drops of hydrochloric (muriatic) acid may be added, and will be detected by the effervescence or bubbling as the carbonic acid gas passes off. A better plan is to place a lump of clay in the small amount of acid, as the clay absorbs the liquid so rapidly the effervescence may be overlooked. Good fire brick is low in lime. If there be low percentage of iron present and a higher percentage of lime (about three times the iron), the clay product will burn buff. If the high percentage of lime be due to lumps of lime carbonate, the brick on burning will crack and warp. Very high percentages of lime are apt to ruin the clay. It is not always possible to predict the color of the burned ware from the color of the clay. Red clays will usually burn red, blue clays may burn red or buff. Dark or black clays are usually high in organic matter, and may burn red or buff. The color of clays is discussed more fully in the preceding Chapter (IV, of Volume III).

"6. The slaking of clays or the crumbling down in tempering is tested by dropping a lump of clay in a cup of water. Some clays slake in a very few minutes, and so are easily tempered. Shales slake usually only after a long time, and require fine grinding.

"These various tests can be made by any person, and while not conclusive, afford the basis for an approximate opinion on the nature of the clay."

From the recommendations given above by Grimsley regarding prospecting for clays, it will be noted that much work must be done before it is finally determined that a clay is suitable for a certain purpose. No special samples of clay were collected for this Report since the limited number of tests it would have been possible for the Survey to make would not have been conclusive. The final test is the physical one and the equipment of the Survey Laboratory is not extensive enough at the present time to render this service. It is recommended that such samples as it is desirable to test be sent to a reputable ceramist or to a specially equipped laboratory where the samples may be actually worked into the finished product to determine their true worth.

BUILDING STONE.

The sandstones of Hardy County vary from flaggy and shaly beds not durable enough to be used as building stone to great massive ledges, 50 to 250 feet or more in thickness, that will split into any desired size. The basal Pocono contains some massive quartzitic ledges from which large building blocks could be obtained. In the Catskill Series, the sandstones are highly micaceous, usually flaggy and shaly so that they are not generally suited for building stone. In the

Chemung and Portage they are flaggy, and in the Genesee, Hamilton, and Marcellus none are found. The Oriskany is composed mostly of massive sandstone which splits easily but is often too soft for general use. The Bloomsburg contains a sandstone which is frequently close-grained and very hard and should be quite durable. The Iron Sandstone of the Clinton is massive, red in color, and very hard. The iron it contains makes it very heavy which might operate against its use as a building stone. The White Medina is an immense quartzite from which blocks of any desired size could be split. It is very durable but would be difficult to quarry and fashion into structures. The Red and Gray Medina are both shaly and flaggy and have little to commend them as building stones.

There are several limestones of almost unlimited extent in Hardy County but they have not been used for construction work. Most of them are hard and compact with an irregular fracture which makes them difficult to quarry and dress.

There are no commercial building stone quarries in the county. A few small quarries from which foundations for houses and bridges have been cut were noted at several points in the county, while a few quarries have been operated for road material.

ROAD MATERIAL.

River and Creek Gravel.—In many previous Reports of the Survey, attention has been called to the fact that most of the rivers and creeks of the State contain an abundant supply of gravel, which, being the more resistant portions of the rocks from which they are derived, afford good and cheap material for improving roads. This gravel can be used to advantage in the improvement of muddy sections of secondary roads where a hard surface may be too expensive and it may also be used as aggregate for concrete paving and structures.

Chert.—There are many outcrops of chert in Hardy County which could be developed for use on roads. The chert is generally porous and inclined to disintegrate into small angular fragments. When placed on the road it makes a sort of macadam which soon cements because of its lime content. It will be found at the outcrop of the Oriskany Sandstone shown on Map IV.

Sand.—Sand is generally found along the rivers and creeks of Hardy County. It is another essential material needed in road building, both in masonry construction and in concrete. In the South Branch Valley it is possibly more silty on account of the great amount of Devonian shale intermixed.

Limestone.—The limestones of Hardy County are probably its most valuable road building material. The Helderberg, Bossardville, and Rondout are usually quite hard and durable and their outcrop is so extensive that they may be trucked with ease to almost any point. They are suitable for macadam and have been so used and they are also well adapted for aggregate in concrete.

Brick Material.—As stated under clays and shales, there is an abundance of material that can be made into brick, some of which would probably be durable enough for road surfacing provided a subgrade of concrete be provided to take up the shock of traffic.

Stone for Masonry, Macadam, and Concrete.—There are many sandstone ledges in Hardy County that can be used for general masonry construction, as well as for concrete aggregate if limestone or gravel is not locally available. Sandstone is not ideal for macadam, but some of the more resistant ledges might be employed to local advantage because of low first cost. There is such an abundance of limestone, however, that its use to the exclusion of most other materials would appear desirable. Those sandstones available for masonry construction are: Ridgeley (Oriskany), Williamsport (Bloomsburg), Iron Sandstone (Clinton), and White Medina. In addition some of the beds of the Pocono are massive and durable and some of the Chemung (Hendricks Sandstone especially) and Portage flagstones locally coalesce into more massive deposits that might be of some local value.

Tests by State Road Commission.—In Appendix "B" to this Report will be found numerous tests of road materials made by the Testing Department of the State Road Commission at its laboratory in Morgantown. The Survey is indebted to Fred A. Davis and R. B. Dayton for permission to publish the results of these tests which cover not only those made from materials collected in Hardy and Hampshire Counties but also from Mineral, Grant, Pendleton, Berkeley, Jefferson, Morgan, and Pocahontas Counties. The tables show the source of the material, its nature, the tests made, the project on which it was used, and the purpose to which it was put. Following the tables as a part of the Appendix will be found a Road Material Survey made in May, 1927, in Hampshire County, 13 pages of analyses of road materials made in the laboratory of the State Road Commission, and also a short article headed "Definition of Terms" made up from the latest Standard Specifications for State Road Construction (April, 1926) by the State Road Commission. Following this will be found some statistics based on road mileage in Hampshire and Hardy Counties which will no doubt prove of interest.

SOIL SURVEY.

A survey of the soils of Hampshire and Hardy Counties is being prosecuted during the field season of 1927 by the Bureau of Soils of the United States Department of Agriculture in cooperation with the West Virginia Geological Survey. A bulletin and soil maps of these counties will then be prepared by the Soil Expert, Mr. B. H. Williams, and published by the Department of Agriculture. Copies of the bulletin and maps will later be distributed by the West Virginia Geological Survey to all those receiving the Detailed Report on these counties. Extra copies of the soil report and maps may be procured from the U. S. Department of Agriculture at small cost. A short description of the area, climate, agriculture, and the various types of soils will be included, while the maps, on the same topographic base as used for the maps accompanying the Detailed County Report, will show the areas where each type of soil is found. The summary given in the soil report, as well as the descriptions of the types, will show the class of agriculture best suited for each soil type. The farmers of Hampshire and Hardy Counties will find the soil report of much interest and value.

STATISTICS.

Some interesting items shown by the Personal Property assessment of Hardy County for 1923 are revealed by the following figures:

Capitations (State):			
Capon District	343		
Wardensville	48	391	
Lost River District		643	
Moorefield District	594		
Moorefield	180	774	
South Fork District		461	2,269

Horses, Mules, etc.:	Number.	Value.
Capon District	423	$ 22,585
Lost River District	754	45,875
Moorefield District	800	50,495
South Fork District	694	41,565
Totals	2,671	$160,520

Cattle:	Number.	Value.
Capon District	1,203	$ 27,110
Lost River District	2,666	62,720
Moorefield District	3,221	109,385
South Fork District	2,733	91,365
Totals	9,823	$290,580

Sheep:	Number.	Value.
Capon District	1,403	$ 6,540
Lost River District	3,505	16,915
Moorefield District	3,822	18,795
South Fork District	2,952	14,430
Totals	11,682	$56,680

Hogs:	Number.	Value
Capon District	259	$ 3,475
Lost River District	1,423	8,475
Moorefield District	1,542	10,010
South Fork District	2,556	16,835
Totals	5,780	$38,795

Farm and Garden Utensils:	Value.
Capon District	$ 9,770
Moorefield District	19,135
South Fork District	25,430
Total	$80,590

Agricultural Products and Products of Animals:	Value.
Capon District	$ 1,830
Lost River District	5,645
Moorefield District	4,285
South Fork District	3,110
Total	$14.870

Mined or Manufactured Products:	Value.
Capon District	$ 40
Lost River District	115
Moorefield District	124,645
South Fork District	60
Total	$124,860

Automobiles:	Number.	Value.
Capon District	129	$ 19,040
Lost River District	201	41,965
Moorefield District	280	57,500
South Fork District	135	24,165
Totals	745	$142,670

Bicycles, Carriages, Wagons, etc.:	Number.	Value.
Capon District	43	$ 650
Lost River District	132	2,015
Moorefield District	361	6,430
South Fork District	85	1,240
Totals	621	$10,335

Household Furniture:	Value.
Capon District	$ 25,115
Lost River District	47,805
Moorefield District	79,425
South Fork District	31,060
Total	$183,405

Tangible Personal Property, Incorporated Companies:	Value.
Capon District	$ 50,970
Lost River District	145,010
Moorefield District	8,500
South Fork District	24,890
Total	$229,370

Chattels, Real (Leaseholds):	Value.
Capon District	$ 19,965
Moorefield District	123,295
Total	$143,260

All other tangible property not otherwise assessed:	Value.
Capon District	$ 2,095
Lost River District	34,520
Moorefield District	124,215
South Fork District	23,800
Total	$184,630

Net amount of money after deducting indebtedness:	Value.
Capon District	$ 62,640
Lost River District	138,505
Moorefield District	427,060
South Fork District	177,090
Total	$805,295

Value capital, surplus, and undivided profits, banks:		Value.
Capon District (Capon Valley Bank, Wardensville, 250 shares at $140.00)		$ 35,000
Moorefield District:		
South Branch Valley Bank (1,000 shares at $130.00 less $16,430 deductions)	$113,570	
Hardy County Bank (500 shares at $80.00)	40,000	153,570
Total		$188,570

Total amount of all personal property under different heads:	Value.
Capon District	$ 286,825
Lost River District	575,820
Moorefield District	1,316,745
South Fork District	475,040
Total (including bank stocks)	$2,654,430

Total value of all personal property as fixed by Board of Equalization and Review:	Value.
Capon District	$ 253,295
Lost River District	576,440
Moorefield District	1,182,575
South Fork District	474,755
Total (exclusive of bank stocks)	$2,487,065

Total value of all personal property (fixed by Board of Equalization and Review) including bank stocks:

	Value.
Capon District	$ 288,295
Lost River District	576,440
Moorefield District	1,336,145
South Fork District	474,755
Total	$2,675,635

Total value of all personal property in Moorefield ---- $545,540

Rates of Taxation in Hardy County.

Districts and Towns	1918	1919	1920	1921	1922	1923
Capon District	$1.16	1.69	1.90	1.90	1.81½	2.42
Wardensville	0.91	1.39	1.75	1.75	1.66½	2.27
Lost River District	0.98	1.49	1.66	1.61	1.57	1.72
Moorefield District	1.06	1.59	1.71	1.65	1.70	1.85
Moorefield	1.01	1.44	1.56	1.50	1.55	1.70
South Fork District	0.96	1.57	1.66	1.60	1.57	1.63

The records in the County Clerk's office date from March 17, 1786, when the first will, first mortgage, and first deed were entered of record. The first will, recorded in Will Book No. 1, page 1, is that of Adam Couchman, dated February 21, 1782, and probated March 17, 1786. The first mortgage was from Robert Higgins to Joseph Janney & Co., dated February 8, 1786, and recorded in Deed Book No. 1, page 1, securing a debt of 498 pounds, 8 pence, ½ penny. The first deed was from Henry Rule, Senr. (of North Carolina) to Henry Rule, Jr., (of Hardy Co., Va.), dated March 4, 1786, recorded March 17, 1786, in Deed Book No. 1, page 4, and conveyed 110 acres on the north side of North Mill Creek for a consideration of 5 pounds.

The following statistics regarding agriculture in Hardy County are taken from the United States Census Returns for 1920:

Number of Farms—1920	1,228	
1910	1,106	
1900	840	
Number of Farmers, 1920—Male	1,176	
Female	52	1,228
Color and Nativity of Farmers:		
Native white	1,221	
Foreign-born white	4	
Negro and other nonwhite	3	1,228

All Farms, classified by size:

	Number	
Under 3 acres	0	
3 to 9 acres	37	
10 to 19 acres	51	
20 to 49 acres	143	
50 to 99 acres	244	
100 to 174 acres	305	
175 to 259 acres	187	
260 to 499 acres	164	
500 to 999 acres	66	
1000 acres and over	31	1,228

Land and Farm Area:

Approximate land area, 1920	367,360 acres.*
Land in farms, 1920	269,689 acres.
1910	248,869 acres.
1900	256,149 acres.
Improved land in farms, 1920	104,257 acres.
1910	94,520 acres.
1900	79,579 acres.
Woodland in farms, 1920	153,171 acres.
Other unimproved land in farms, 1920	12,261 acres.
Per cent. of land area in farms, 1920	73.4
Per cent. of farm land improved, 1920	38.7
Average acreage per farm, 1920	219.6
Average improved acreage per farm, 1920	84.9

Value of Farm Property:

All farm property, 1920	$8,550,663
1910	3,997,661
1900	2,414,536
Land in farms, 1920	5,232,529
1910	2,519,143
1900	1,551,090
Farm buildings, 1920	1,608,251
1910	641,165
1900	340,180
Implements and Machinery, 1920	441,953
1910	102,227
1900	64,480
Live stock on farms, 1920	1,267,930
1910	735,126
1900	458,786
Average values, 1920:	
All property per farm	$ 6,963
Land and buildings per farm	5,571
Land alone per acre	19.40

Farms operated by owners:

Number of farms, 1920	1,047
1910	975
1900	701
Per cent. of all farms, 1920	85.3
Land in farms, 1920	220,626 acres.
Improved land in farms, 1920	84,872 acres.
Value of land and buildings, 1920	$5,250,949

*Area as calculated for this Report by Price=368.333 acres.

Degree of ownership, 1920:

Farmers owning entire farm	956	
Farmers hiring additional land	91	

Color and nativity of owners, 1920:

Native white owners	1,041	
Foreign-born white owners	4	
Negro and nonwhite owners	2	1,047

Farms operated by managers:

Number of farms, 1920	29
1910	7
1900	7
Land in farms, 1920	10,188 acres.
Improved land in farms, 1920	4,728 acres.
Value of land and buildings, 1920	$482,155

Farms operated by tenants:

Number of farms, 1920	152
1910	124
1900	132
Per cent. of all farms, 1920	12.4
Land in farms, 1920	38,875 acres.
Improved land in farms, 1920	14,657 acres.
Value of land and buildings, 1920	$1,107,676

Form of tenancy, 1920:

Share tenants	86	
Croppers	11	
Share-cash tenants	3	
Cash tenants	26	
Standing renters	0	
Unspecified	26	152

Color and nativity of tenants, 1920:

Native white tenants	151	
Foreign-born white tenants	0	
Negro and other nonwhite tenants	1	152

Live Stock on Farms and Ranges, 1920, and Live-Stock Products, 1919:

Farms reporting domestic animals	1,193
Value of all domestic animals	$1,199,932

	Number.	Value.
Horses	2,726	$259,948
Mules	233	24,240
Asses and burros	1	15
Cattle	10,791	666,015
Beef cattle	7,488	473,486
Dairy cows	3,303	192,529
Sheep	14,587	148,673
Goats	1,206	4,993
Swine	8,477	96,048

Poultry and bees, 1920:

Chickens	76,699
Other poultry	2,389
Value of all poultry	$65,235
Bees, number of hives	535
Bees, value	$ 2,763

Live-stock Products, 1919:

Dairy Products:

Milk produced (as reported)	710,003 gallons.
Milk sold	8,569 gallons.
Cream sold	0
Butter fat sold	200 pounds.
Butter made on farms	118,026 pounds.
Butter sold	34,905 pounds.
Cheese made on farms	28,027 pounds.
Value of dairy products	$ 64,425
Receipts from sale of dairy products	$ 17,552
Average production of milk per dairy cow	271 gallons.

Eggs and chickens:

Eggs produced (as reported)	415,331 dozen.
Eggs sold	311,526 dozen.
Chickens raised (as reported)	105,198
Chickens sold	46,211
Value of chickens and eggs produced	$243,925
Receipts from sale of chickens and eggs	$160,201

Honey and Wax:

Honey produced	5,034 pounds.
Wax produced	105 pounds.
Value of honey and wax	$1,699

Wool:

Sheep shorn	14,082
Wood produced (as reported)	67,974 pounds.
Value	$40,333

Domestic animals not on farms or ranges, 1920:

Inclosures reporting domestic animals	189
Horses, total number	145
Mules, total number	28
Asses and burros, total number	0
Cattle, total number	131
Dairy cows	106
Sheep, total number	36
Goats, total number	0
Swine, total number	463

Crops:

Value of All Crops, total	$1,931,312
Cereals	980,215
Other grains and seeds	9,476
Hay and forage	412,890
Vegetables	224,924
Fruits	300,390
All other crops	3,417

Selected crops (as harvested and produced):

Total	23,883 acres.
Bushels	551,482 bushels.

	Acres.	Bushels.
Corn	10,053	363,994
Oats	2,474	43,079
Wheat	7,414	102,645
Barley	44	940
Rye	2,602	23,283
Buckwheat	1,296	17,541

Other grains and seeds:

	Acres.	Bushels.
Dry edible beans	21	99
Dry peas	4	50

Hay and forage:

	Acres.	Tons.
Total	10,326	23,156
All tame and cultivated grasses	8,437	9,410
Timothy alone	2,027	2,121
Timothy and clover mixed	4,081	4,540
Clover alone	863	1,195
Alfalfa	171	343
Other tame and cultivated grasses	1,295	1,211
Wild, salt, or prairie grasses	27	31
Small grain cut for hay	209	438
Annual legumes cut for hay	136	381
Silage crops	1,265	12,312
Corn cut for forage	247	580
Kafir, sorghum, etc., for forage	5	4
Root crops for forage	0	0

Vegetables:

Potatoes (Irish or white)	555	49,511
Sweet potatoes and yams	8	1,115
Other vegetables	13	-----

Miscellaneous crops:

Sorghum grown for sirup	10 acres	29 tons.
Sirup made		494 gallons.

Fruits:

Small fruits:

Total	14 acres.	5,662 quarts.
Strawberries	5 acres.	1,641 quarts.
Raspberries	4 acres.	2,703 quarts.
Blackberries and dewberries	1 acre.	631 quarts.

Orchard fruits:

	Trees not of Bearing Age.	Trees of Bearing Age.	Bushels Harvested.
Total	19,725	246,221	148,773
Apples	13,559	110,948	76,935
Peaches	5,316	124,668	68,264
Pears	262	2,901	799
Plums and prunes	211	1,738	622
Cherries	377	5,966	2,153
	Vines not of Bearing Age.	Vines of Bearing Age.	Pounds Harvested.
Grapes	412	4,911	41,486

Mortgage Debt Reports, 1920:

For all farms operated by owners:

Number free from mortgage debt	758
Number with mortgage debt	195
Number with no mortgage debt report	94

For farms consisting of owned land only:

Number of farms reporting amount of debt	167
Value of land and buildings	$1,106,315
Amount of mortgage debt	222,811
Rate of debt to value	20.1 per cent.
Average rate of interest paid	5.9 per cent.

Farm Expenditures for Labor, Fertilizer and Feed, 1919:

Labor:

Farms reporting	467
Total expenditure	$145,705
Amount in cash	$124,737
Value of rent and board furnished	$ 20,968

Fertilizer:

Farms reporting	759
Amount expended	$ 36,742

Feed:

Farms reporting	543
Amount expended	$ 77,141

Real Estate Assessments, Hardy County.

(By Board of Equalization and Review).

District.	1918.	1919.	1920.	1921.	1922.
Capon District	$ 325,720	$ 335,070	$ 350,245	$ 376,200	$ 432,970
Wardensville	31,670	34,545	36,580	43,010	54,665
Total (C. D.)	357,390	369,615	386,825	419,210	487,635
Lost River Dist.	539,105	541,880	564,195	669,130	779,000
Moorefield Dist.	960,260	959,940	1,006,300	995,770	1,132,000
Moorefield (Town)	294,225	301,895	307,345	311,720	351,195
Total (M. D.)	1,254,485	1,261,835	1,313,645	1,307,490	1,483,215
South Fork Dist.	879,555	894,595	929,860	877,765	1,087,810
Totals	$3,030,535	$3,067,925	$3,194,525	$3,273,595	$3,837,660

Public Utilities, Hardy County, 1922.

Capon District	$ 560.00
Lost River District	2,203.00
Moorefield District	187,557.00
Moorefield Municipality	10,000.00
South Fork District	159,760.00
Total	$360,080.00

Total Assessments, Hardy County, 1922.

Real Estate	$3,837,660
Personal Property	2,618,865
Public Utilities	360,080
Total	$6,816,605

APPENDIX "A".

LEVELS ABOVE MEAN TIDE.

RAILROAD LEVELS.

BALTIMORE AND OHIO RAILROAD.

(Elevations based on top of rail).

Main Line.

Mi. from Bruns-wick	Stations	State	County	Eleva-tion Feet
78.2	Paw Paw -------	West Virginia	Morgan -----	529.83
80.8	Little Cacapon --	West Virginia	Hampshire ---	533.09
83.0	Okonoko -------	West Virginia	Hampshire ---	539.01
85.8	French ---------	West Virginia	Hampshire ---	541.48
88.4	Green Spring ---	West Virginia	Hampshire ---	555.97
94.9	Patterson Creek-	West Virginia	Mineral -----	574.16
100.1	Evitts Creek ----	Maryland ----	Allegany ----	637.44
102.5	Cumberland ----	Maryland ----	Allegany ----	632.09

Petersburg (South) Branch.

Mi. from Green Spring	Stations	State	County	Elevation Feet
0.0	Green Spring ---	West Virginia	Hampshire --	557.9
1.3	Millen ---------	West Virginia	Hampshire --	575.3
3.3	Donaldson ------	West Virginia	Hampshire --	623.3
7.3	Milleson --------	West Virginia	Hampshire --	777.9
7.5	Springfield -----	West Virginia	Hampshire --	780.6
9.3	Grace ----------	West Virginia	Hampshire --	653.1
10.0	Ritters ---------	West Virginia	Hampshire --	635.0
10.9	Ridgedale ------	West Virginia	Hampshire --	655.5
12.5	Rocks ----------	West Virginia	Hampshire --	667.4
13.3	Vance ----------	West Virginia	Hampshire --	655.2
15.2	Wapocomo -----	West Virginia	Hampshire --	667.3
15.4	Romney Junction	West Virginia	Hampshire --	668.6
16.4	Romney --------	West Virginia	Hampshire --	731.0
17.6	West Romney --	West Virginia	Hampshire --	682.5
20.7	Hampshire Club-	West Virginia	Hampshire --	717.4
22.4	Johnson --------	West Virginia	Hampshire --	728.2
23.7	Pancake --------	West Virginia	Hampshire --	725.4
26.2	Glebe -----------	West Virginia	Hampshire --	725.2
27.5	Wickham -------	West Virginia	Hampshire -	742.3
32.2	Sycamore ------	West Virginia	Hardy -------	771.7
33.3	McNeill --------	West Virginia	Hardy -------	776.6
35.2	Mapleton -------	West Virginia	Hardy -------	771.5
36.6	Cunningham ----	West Virginia	Hardy -------	787.1
37.4	Meadow --------	West Virginia	Hardy -------	803.4
39.1	Moorefield ------	West Virginia	Hardy -------	820.5
41.3	Taylor ---------	West Virginia	Hardy -------	823.6
43.5	Brook Hill -----	West Virginia	Hardy -------	852.0
45.1	Spring Brook ---	West Virginia	Hardy -------	859.4
46.8	Durgon ---------	West Virginia	Hardy -------	877.9
48.7	Welton ---------	West Virginia	Hardy -------	901.5
51.9	Petersburg -----	West Virginia	Grant -------	933.5
52.0	End of Line ----	West Virginia	Grant -------	936.0

The elevations and distances given above are as recently given the Survey by the Chief Engineer of the Baltimore and Ohio Railroad through the courtesy of Dr. G. P. Grimsley, of the Commercial Development Department of that road, the same having been recently resurveyed for valuation purposes for the United States Government.

The Western Maryland Railway parallels the Baltimore and Ohio Railroad main line on the opposite side of the Potomac River and the North Branch of the Potomac in Maryland just north of the Hampshire County line. Below are given the levels on the Main Line of this road from Roundtop, Maryland, to South Cumberland.

THE WESTERN MARYLAND RAILWAY.

(Elevations based on sub-grade; for top of rail about 1½ feet should be added).

Main Line.

Mi. from Baltimore	Stations	State	County	Elevation Feet
120.4	Roundtop	Maryland	Washington	482
127.4	Pearre	Maryland	Washington	458
131.1	Little Orleans	Maryland	Allegany	494
132.6	Doe Gully	West Virginia	Morgan	500
137.1	Baird	West Virginia	Morgan	525
143.8	Fairplay	Maryland	Allegany	552
147.1	Town Creek	Maryland	Allegany	549
151.2	Oldtown	Maryland	Allegany	569
155.9	Sloan	Maryland	Allegany	587
163.5	So. Cumberland	Maryland	Allegany	624

UNITED STATES GEOLOGICAL SURVEY LEVELS.

The various topographic quadrangles (Flintstone, Paw Paw, Keyser, Hanging Rock, Capon Bridge, Middletown, Greenland Gap, Moorefield, Wardensville, Petersburg, Orkney Springs, and Edinburg) which make up the areas of Hampshire and Hardy Counties have been covered with a network of primary spirit-levels run by the United States Geological Survey. In addition to these a precise line has been run by the United States Coast and Geodetic Survey and the Baltimore and Ohio Railroad along the main line of the latter which passes through the northern portion of Hampshire County.

The following descriptive remarks are quoted from Bulletin No. 632 of the United States Geological Survey, pages 5-7; 1916:

"Classification.—The elevations are classified as precise or primary, according to the methods employed in their determination. The former are determined by lines of levels run either in both forward and backward directions or by simultaneous double-rodded lines, a high-grade instrument being used and special precautions being taken in observations and reduction to correct errors and make the line continuously good throughout. The latter or primary levels are determined with the Y level, precautions being taken against only the principal errors and the levels being run mostly in circuits of single lines. The allowable limit of error observed on the precise work already done by the Geological Survey in this State is represented in feet by 0.02 times the square root of D, and that for the primary work by 0.05 times the square root of D, in which D is the length of the circuit in miles.

"**Bench Marks.**—The standard bench marks are of two forms. The first form is a circular bronze or aluminum tablet, 3½ inches in diameter and ¼ inch thick, having a 3-inch stem, which is cemented in a drill hole in solid rock in the wall of some public building, a bridge abutment, or other substantial masonry structure. The second form, used where masonry or rock is not available, consists of a hollow wrought-iron post 3½ inches in outer diameter and 4 feet in length. The bottom is spread out to a width of 10 inches in order to give a firm bearing on the earth. A bronze or aluminum cap is riveted upon the top of the post which is set about 3 feet in the ground. A third style of bench mark, with abbreviated lettering, is used for unimportant points. This consists of a special copper nail 1½ inches in length driven through a copper washer ⅞ inch in diameter. The tablets as well as the caps on the iron posts are appropriately lettered, and cooperation by States is indicated by the addition of the State name.

"The numbers stamped on the bench marks described in the following pages represent the elevations to the nearest foot as determined by the levelman. These numbers are stamped with 3/16-inch steel dies on the tablets or post caps, to the left of the word 'Feet'. The office adjustment of the notes and the reduction to mean sea-level datum may so change some of the figures that the original markings are 1 to 2 feet in error. It is assumed that engineers and others who have occasion to use the bench-mark elevations will apply to the Director of the United States Geological Survey, at Washington, D. C., for the adjusted values, and will use the markings as identification numbers only.

"**Datum.**—All elevations determined by the United States Geological Survey and United States Coast and Geodetic Survey are referred to mean sea-level, which is the level that the sea would assume if the influence of winds and tides were eliminated. This level is not the elevation determined from the mean of the highest and the lowest tides, nor is it the half sum of the mean of all the high tides and the mean of all the low tides, which is called the half-tide level. **Mean sea-level is the average height of the water, all stages of the tide being considered.** It is determined from observations made by means of tidal gages placed at stations where local conditions, such as long narrow bays, rivers, and like features, will not affect the height of the water. To obtain even approximately correct results these observations must extend over at least one lunar month, and if accuracy is desired they must extend over several years. At ocean stations the half-tide level and the mean sea-level usually differ but little. It is assumed that there is no difference between the mean sea-levels determined from observations in the Atlantic Ocean, the Gulf of Mexico, and the Pacific Ocean.

"The connection with tidal stations for bench marks in certain areas that lie at some distance from the seacoast is still uncertain, and this fact is indicated by the addition of a letter or word to the right of the word 'Datum' on tablets and posts. For such areas corrections for published results will be made from time to time as the precise-level lines of the United States Geological Survey, the United States Coast and Geodetic Survey, or other Government organizations are extended."

The precise levels of the United States Coast and Geodetic Survey and the Baltimore and Ohio Railroad affecting the Hampshire County area are given below as also the primary levels by the United States Geological Survey, run in cooperation with the West Virginia Geological Survey, taken in part from Bulletin No. 632 of the United States Geological Survey, but mainly from unpublished data supplied by the Director of the latter Survey. The levels are given by topographic quadrangles and cover both Hampshire and Hardy Counties. Mileages mentioned in the descriptions of bench marks are road mileages and are not air-line distances from the towns and post-offices mentioned to the points where the levels were taken:

FLINTSTONE QUADRANGLE: HAMPSHIRE COUNTY.

(Latitude 39° 30'-39° 45'; Longitude 78° 30'-78° 45'.)

Third order leveling by Hargraves Wood in 1897:

From Patterson Creek south to Alaska (part of line).

	Feet.
Patterson Creek, north end of Baltimore & Ohio R. R. bridge over Patterson Creek, north side of track, in ballast wall; copper plug marked "574C"	573.887

Third order leveling by F. L. Shalibo in 1920:

From Hanging Rock Quadrangle north along Baltimore and Ohio Railroad.

Green Spring, 2.6 miles southwest of, about 0.5 mile northeast of **Donaldson** flag-stop, in northwest corner of road crossing, in base of telephone-pole; iron spike, painted "611.0"	610.77
Green Spring, 1.7 miles southwest of, on west side of track, in top of north post of hand-car siding; copper nail, painted "582.0"	581.78
Green Spring, 0.7 mile southwest of, on west side of track, in telephone-pole; iron spike, painted "556.1"	555.89
Green Spring, opposite Baltimore and Ohio Railroad station, on north side of track, 6 feet west of train-shed, in cement post; bronze tablet stamped "W. Va. 1920 562"	561.706

French, about 0.8 mile west of, between tracks, in a bridge seat of east abutment of bridge 61A; copper bolt (Baltimore and Ohio Railroad B. M. 137) ---------------------- 554.005

First order leveling by the Baltimore and Ohio Railroad:

From Little Cacapon west along Baltimore & Ohio R. R. to Patterson Creek.

Little Cacapon, near, about 600 feet east of mile-post "Baltimore 157 miles," between tracks in bridge seat of west abutment of bridge 59; copper bolt (B. & O. bench mark 132) ---------------------- 528.057

Okonoko, about 0.8 mile east of, opposite mile-post "Baltimore 158 miles," section of rail set vertically in ground (B. & O. bench mark 133) (destroyed) ---------------------- 534.477

Okonoko, about 0.2 mile west of, about 800 feet east of milepost "Baltimore 159 miles;" copper bolt in north end of west abutment of bridge 60 (B. & O. bench mark 134) ---- 538.368

Okonoko, about 1.2 miles southwest of, opposite mile-pose "Baltimore 160 miles;" section of rail set vertically in ground (B. & O. bench mark 135) ---------------------- 537.082

French, about 0.4 mile east of, opposite mile-post "Baltimore 161 miles;" section of rail set vertically in ground (B. & O. bench mark 136) ---------------------- 540.786

French, about 0.8 mile west of, between tracks; copper bolt in a bridge seat of the east abutment of bridge 61A (B. & O. bench mark 137) ---------------------- 554.005

French, about 1.8 miles west of, near west end of a cut near where mile-post "Baltimore 163 miles" would be if planted, in rock on south side of tracks; copper bolt (B. & O. bench mark 138) ---------------------- 556.219

Green Spring, near, at mile-post "Baltimore 164 miles," on south side of tracks in center of coping of culvert 62; copper bolt (B. & O. bench mark 139) ---------------------- 551.935

Green Spring, about 1 mile west of, opposite mile-post "Baltimore 165 miles;" section of rail set vertically in ground (B. & O. bench mark 140) ---------------------- 559.238

Green Spring, about 2 miles west of, opposite mile-post "Baltimore 166 miles," section of rail set vertically in ground (B. & O. bench mark 141) ---------------------- 562.076

Green Spring, about 3 miles west of, opposite mile-post "Baltimore 167 miles;" section of rail set vertically in ground (B. & O. bench mark 142) ---------------------- 559.677

Dans Run, opposite mile-post "Baltimore 168 miles;" section of rail set vertically in ground (B. & O. bench mark 143) 564.851

Dans Run, about 1 mile west of, opposite mile-post "Baltimore 169 miles;" section of rail set vertically in ground (B. & O. bench mark 144) ---------------------- 565.878

Patterson Creek Cut-Off, about 0.5 mile east of bridge, opposite mile-post "Baltimore 170 miles;" section of rail set vertically in ground (B. & O. bench mark 145) 567.574

Patterson Creek Cut-Off, south end of west abutment of railroad bridge over Patterson Creek (U. S. G. S. bench mark, 574 Patterson Creek) 573.805

Patterson Creek Cut-Off, between tracks, in a bridge seat of the east abutment of bridge 63; copper bolt (B. & O. bench mark 145A) 568.936

Patterson Creek, about 0.3 mile northwest of, opposite mile-post "Baltimore 171 miles;" section of rail set vertically in ground (B. & O. bench mark 146) 575.163

PAW PAW QUADRANGLE: HAMPSHIRE AND MORGAN COUNTIES.

(Latitude 39° 30′-39° 45′; Longitude 78° 15′-78° 30′.)

First order leveling by Baltimore and Ohio Railroad:

From Great Cacapon west along Baltimore & Ohio R. R. to Little Cacapon.

Great Cacapon, 1 mile east of, about 200 feet east of mile-post "Baltimore 131 miles," in large rock on north side of track; copper bolt (B. & O. bench mark 106) 436.334

Great Cacapon, near, between tracks in bridge seat of east abutment of bridge 57 across Cacapon River; copper bolt (B. & O. bench mark 107) 435.613

Great Cacapon, about 1 mile west of, opposite mile-post "Baltimore 133 miles;" section of rail set vertically in ground (B. & O. bench mark 108) 452.978

Woodmont, 0.3 mile west of, opposite mile-post "Baltimore 134 miles;" section of rail set vertically in ground (B. & O. bench mark 109) 450.435

Lineburg, about 0.8 mile east of, opposite telegraph-pole 135/4; copper bolt in rock, on south side of tracks (B. & O. bench mark 110) 454.169

Lineburg, about 0.2 mile west of, opposite mile-post "Baltimore 136 miles;" section of rail set vertically in ground (B. & O. bench mark 111) 458.214

Lineburg, about 1.2 miles south of, 25 feet east of mile-post "Baltimore 137 miles," in a rock on south side of tracks; copper bolt (B. & O. bench mark 112) 468.729

Orleans Road, about 0.8 mile east of, opposite mile-post "Baltimore 138 miles;" section of rail set vertically in ground (B. & O. bench mark 113) 487.850

Orleans Road, about 0.3 mile south of, opposite mile-post "Baltimore 139 miles;" section of rail set vertically in ground (B. & O. bench mark 114) 504.277

Rockwells Run, near, 500 feet beyond mile-post "Baltimore 140 miles," in rock on south side of tracks; copper bolt (B. & O. bench mark 115) ---------- 523.004

Doe Gully, opposite mile-post "Baltimore 141 miles;" section of rail set vertically in ground (B. & O. bench mark 116) --- 546.652

Doe Gully, about 1 mile south of, opposite mile-post "Baltimore 142 miles," section of rail set vertically in ground (B. & O. bench mark 117) ---------- 544.057

Hansrote, 1 mile northeast of, directly opposite mile-post "Baltimore 143 miles;" in rock on south side of tracks; copper bolt (B. & O. bench mark 118) ---------- 520.465

Hansrote, near, opposite mile-post "Baltimore 144 miles;" section of rail set vertically in ground (B. & O. bench mark 119) ---------- 494.218

Hansrote, about 1 mile west of, opposite mile-post "Baltimore 145 miles;" section of rail set vertically in ground (B. & O. bench mark 120) ---------- 497.886

Baird, near, opposite mile-post "Baltimore 146 miles;" section of rail set vertically in ground (B. & O. bench mark 121) 497.643

Baird, about 1 mile southwest of, opposite mile-post "Baltimore 147 miles;" section of rail set vertically in ground (B. & O. bench mark 122) ---------- 489.894

Magnolia, about 1 mile northwest of, opposite mile-post "Baltimore 148 miles;" section of rail set vertically in ground (B. & O. bench mark 123) ---------- 494.074

Magnolia, about 0.2 mile east of, 500 feet beyond mile-post "Baltimore 149 miles;" on south side of tracks in east end of coping of bridge 47D; copper bolt (B. & O. bench mark 124) ---------- 497.630

Magnolia, about 1 mile southeast of, opposite mile-post "Baltimore 150 miles;" section of rail set vertically in ground (B. & O. bench mark 125) ---------- 502.076

Magnolia, about 2 miles south of, opposite mile-post "Baltimore 151 miles;" copper bolt in rock (B. & O. bench mark 126) ---------- 511.521

Paw Paw, about 1 mile north of, opposite mile-post "Baltimore 152 miles;" in a rock on south side of tracks; copper bolt (B. & O. bench mark 127) ---------- 516.226

Paw Paw, about 0.8 mile north of, opposite mile-post "Baltimore 153 miles;" section of rail set vertically in ground (B. & O. bench mark 128) ---------- 526.652

Paw Paw, about 0.2 mile south of, opposite mile-post "Baltimore 154 miles;" section of rail set vertically in ground (B. & O. bench mark 129) ---------- 534.067

Paw Paw, 1.5 miles south of, opposite mile-post "Baltimore 155 miles;" section of rail set vertically in ground (B. & O. bench mark 130) ---------- 532.072

Little Cacapon, about 1 mile east of, about 500 feet east of mile-post "Baltimore 156 miles;" on south side of tracks in middle stone of coping of culvert; copper bolt (B. & O. bench mark 131) ---------------------------------- 528.851

Third order leveling by C. B. Bailey in 1898 and Chas. M. Smith in 1899:

From Rock Gap, east to Stottlers Crossroads.

Rock Gap, 700 feet west of Fearnow's house, 10 feet north of road at summit of gap, in rock; aluminum tablet stamped "761C" -- 760.666

From Great Cacapon via Long Hollow Run to Fisher Ford (double-targeted spur line.)

Great Cacapon, Md., on Lock 55 of Dam No. 6; U. S. C. & G. S. bench mark "C" ------------------------------------ 443.811

Fisher Ford, in large boulder, southeast corner of road; aluminum tablet stamped "Maryland 543C" --------------- 543.188

Third order leveling by E. E. Harris in 1921:

From Cacapehon, Capon Bridge Quadrangle, north along highway to Little Cacapon.

Little Cacapon, 1.46 miles south of, in northeast corner of concrete railing of bridge over Little Cacapon River; chiseled square, "T. B. M. 560.3" marked on bridge ---------- 560.17

Water surface under east side of above bridge, marked "543" at 8 a. m., May 9, 1921---------------------------------- 543.

Little Cacapon 0.78 mile south of, on north edge of road, in center of top of concrete culvert; chiseled square, "T. B. M. 547.5" marked on culvert --------------------------- 547.44

Little Cacapon, in front of station; top of nearest rail------- 535.76

Little Cacapon, near, about 600 feet east of mile-post "Baltimore 157 miles," between tracks in bridge seat of west abutment of bridge 59; copper bolt (B. & O. B. M. 132) (Bulletin 632, p. 143) -------------------------------- 528.057

Little Cacapon, 1.04 miles east of, on north side of tracks, in west side of iron framework to semaphore E 155-41; top of large iron bolt, not marked -------------------------- 539.90

From point south of Fisher Ford in Capon Bridge Quadrangle north along highway to Fisher Ford.

Largent, 2.55 miles north of, on west edge of road, 40 feet north of road west and trail east, in west root of 12-inch elm tree; copper nail and washer, "U. S. 697.6 B. M." marked on tree -------------------------------------- 697.34

Largent, 3.47 miles north of, on west edge of road and south edge of lane crossing river, on top of flat boulder; chiseled square, "U. S. 514.2 B. M." marked on boulder------ 513.91

Largent, 4.20 miles north of, in southwest corner of road forks, in north root of 48-inch oak tree; copper nail and washer, "U. S. 604.7 B. M." marked on tree ------------------- 604.41

Fisher Ford, in large boulder, southeast corner of road; aluminum tablet stamped "MARYLAND 543 C" (Bulletin 632, p. 16) -- 543.188

Reference bench mark, 52 feet N. 35° W., in east root of 38-inch oak tree; copper nail and washer (Bulletin 632, p. 16) 539.69

KEYSER QUADRANGLE: HAMPSHIRE AND MINERAL COUNTIES.

(Latitude 39° 15′-39° 30′; Longitude 78° 45′-79°.)

First order leveling by Baltimore and Ohio Railroad:

Along Baltimore and Ohio R. R. near Keyser.

Keyser, near, opposite telegraph-pole 201/8, set between tracks in south abutment of bridge; copper bolt (B. & O. bench mark 22) -------------------------------------- 800.700

Keyser, near center of Keyser yards, opposite mile-post 202; section of rail set vertically in ground (B. & O. bench mark 23) --- 827.000

Keyser, at north end of Keyser yards, opposite mile-post 203; section of rail set vertically in ground (B. & O. bench mark 24) --- 837.597

Keyser, near, opposite mile-post 204; section of rail set vertically between tracks (B. & O. bench mark 25) -------- 854.578

Third order leveling by E. E. Harris in 1916:

From Keyser southwest along highway to west border of Quadrangle.

Keyser, near center of Keyser yards, opposite old mile-post "202", section of rail set vertically in ground; B. & O. b. m. marked "23" ------------------------------------- 827.000

Keyser, opposite telephone-pole 201/8, between tracks, in south abutment of bridge over New Creek; copper bolt, B. & O. b. m. 22 (Bull. 632, p. 145) -------------------- 800.700

Keyser Court-House, in east end of second concrete step; bronze tablet stamped "809 W. Va 1916" -------------- 809.020

Keyser, 1.0 mile southwest of, in northwest end of concrete culvert over small run, just south of road forks; chiseled square marked "824.7 U. S. B. M." ------------------ 824.77

Keyser, 2.1 miles southwest of, in northwest corner of culvert over Stony Run; chiseled square marked "859.4 U. S. B. M." -- 859.43

From point on west border of Quadrangle east of Laurel Dale, along highways east and northeast down Patterson Creek to Frankfort (Alaska).

Laurel Dale, 7.9 miles east of, 30 feet north of highway, 250 feet south of farm house of J. B. Rawlings, in root of large white oak tree, 3 feet in diameter; copper nail marked "882.8" ---------- 883.09

Burlington, 4.4 miles southwest of, 900 feet north of road forks, in center of top rail (west) of concrete bridge over Mikes Run; bronze tablet stamped "807 W. VA. 1916" --- 807.390

Burlington, 3.3 miles southwest of, on west side of highway, 350 feet south of point where small run crosses road, in root of 2.5-foot white oak tree; copper nail and washer marked "U. S. B. M. 852.8" ---------- 853.05

Burlington, 2.5 miles southwest of, on west side of highway at road forks, in west end of south stone abutment of wooden bridge over Mud Run; bronze tablet set vertically, stamped "787 W. VA. 1916" ---------- 787.464

Burlington, 0.8 mile southwest of, on west side of highway, 200 feet west of farm house, in 3-1/2-foot white oak tree; copper nail marked "U. S. B. M. 756.3" ---------- 756.48

Burlington, set in west end of bridge seat of north abutment of highway bridge over Mill Creek; bronze tablet stamped "739 W. VA. 1916" ---------- 739.029

Mill Creek, surface of water under above bridge ---------- 733.6

Patterson Creek, at point where highway crosses creek, surface of water, August 15, 1916 ---------- 724.2

Burlington, 1.4 miles northeast of, in east side of highway, in front of farm house of I. I. Whipp, in root of stump 8 feet high; copper nail and washer marked "U. S. B. M. 725.3" ---------- 725.54

Burlington, 2.3 miles northeast of, in west end of north bridge seat of wooden bridge over Johnson Run; chiseled square marked "U. S. B. M. 713.1" ---------- 713.33

Burlington, 3.2 miles northeast of, 80 feet south of road forks, in north end of east concrete foundation of wooden bridge over small run; bronze tablet stamped "709 W. VA. 1916" 708.893

Headsville, 1.0 mile southwest of, 600 feet north of farm house of Maple Hill Farm, east side of highway in east end of lower north parallel support of wooden bridge over small run; copper nail and washer marked "U. S. B. M. 695.1"-- 695.25

Headsville, 0.2 mile east of post-office, set in east end of north bridge seat of highway bridge over Patterson Creek; bronze tablet stamped "685 W. VA. 1916" ---------- 685.210

Headsville, 1.0 mile north of, on highest point of road, just south of road forks, on west side of highway, in root of large oak tree; copper nail and washer marked "U. S. B. M. 908.2" ---------- 908.42

Headsville, 2.33 miles north of, 350 feet north of farm house, in north end of west concrete abutment of wooden bridge over small run; chiseled square marked "U. S. B. M. 674.7" 674.89

Reeses Mill, 0.16 mile north of, set on east end of south bridge seat of highway bridge over Patterson Creek; bronze tablet stamped "655 W. VA. 1916" ------------------ 655.077

Reeses Mill, 1.22 miles northeast of, 30 feet west of road 500 feet north of farm house, in root of walnut tree 3 feet in diameter; copper nail and washer marked "U. S. B. M. 647.8" -- 648.03

Champwood, 0.24 mile southwest of, in east end of north abutment of concrete culvert over Hazel Run; chiseled square marked "U. S. B. M. 641.4" ------------------------- 641.55

Champwood, 1.67 miles northeast of, in east end of north abutment of concrete culvert over Rinehart Run; bronze tablet stamped "628 1916 W. Va." ------------------------- 628.569

Champwood, 2.81 miles north of, west side of highway, directly in front of farm house, in root of large walnut tree; copper nail and washer marked "U. S. B. M. 622.9" ----------- 623.09

Champwood, 3.84 miles north of, set in north end of east abutment of concrete culvert over Sulphur Spring Run; bronze tablet stamped "646 1916 W. VA." ------------------ 646.022

Frankfort, 1.13 miles south of, in front of farm house, in west side of highway, in root of stump 10 feet high; copper nail and washer marked "U. S. B. M. 608.4" ---------- 608.60

From Headsville northwest along highways to Keyser.

Headsville Post-Office, on pointed sandstone; chiseled cross marked "U. S. 682.6" ------------------------------ 682.71

Headsville, 1.5 miles west of, north side of highway, 60 feet east of stream crossing on south bank of Staggs Run, directly in front of farm house of R. Ludwig, in stump at south end of foot-bridge; copper nail and washer marked "U. S. B. M. 756.5" -------------------------------- 756.71

Headsville, 2.0 miles west of, 30 feet south of highway, 60 feet northeast of house, east side of north concrete support of wooden bridge over drain; chiseled square marked "U. S. B. M. 799.2" -------------------------------- 799.38

Headsville, 2.4 miles northwest of, south side of highway, in front of residence of D. C. Parish, on top in center of south wall of concrete culvert over small run; bronze tablet stamped "909 W. VA. 1916" ------------------ 908.843

Headsville, 3.0 miles northwest of, in low gap between fork of Cabin Run and Staggs Run; chiseled cross marked "U. S. 1119" --------------------------------------1,119.26

Headsville, 3.2 miles northwest of, at road forks on north side of main highway, in root of hickory tree; copper nail and washer marked "U. S. B. M. 986.8" ---------------- 986.96

Fountain, in west end of north wall of concrete bridge over Cabin Run; bronze tablet set vertically, stamped "811 1916 W. VA." ---------- 811.343

Fountain, 0.90 mile northwest of, at forks of lane north, on north side of main highway; chiseled square in sandstone ledge marked "U. S. B. M. 1094.3" ---------- 1,094.46

Keyser, 2.00 miles southeast of, in Hammicks Gap, on north side of highway, in fragment ledge of limestone; chiseled square marked "U. S. B. M. 1350.8" ---------- 1,351.05

Keyser, 1.26 miles southeast of, on north side of highway at road forks, opposite private lane, in root of south tree of twin white oak trees; copper nail and washer marked "U. S. B. M. 933.2" ---------- 933.43

From southwest corner of Quadrangle northeast along highway to bridge over Mikes Run. Leveled twice.

Leveling by F. L. Shalibo and Walter McCrea in 1919:

Williamsport, 4.7 miles north of, on east edge of road, near rail fence, opposite T road southwest, 50 feet north of stream, in cement post; bronze tablet stamped "850 W. VA." ---------- 849.500

Williamsport, 5.6 miles north of, on west edge of road, opposite field gate, 50 feet north of small stream, in root of twin trees; copper nail, painted "844.6" ---------- 843.61

Williamsport, 6.8 miles north of, at T road west, on southeast corner of cement culvert; chiseled square, painted "827.6" ---------- 826.50

Burlington, 4.4 miles southwest of, 900 feet north of road forks, in center of top rail, west, of concrete bridge over Mikes Run; bronze tablet stamped "W. VA. 807" ---------- 807.390

From Burlington east along highway to (Moorefield) Junction. Leveled twice.

Leveling by F. L. Shalibo in 1920:

Burlington, in west end of bridge seat of north abutment of highway bridge over Mill Creek; bronze tablet stamped "739 W. VA. 1916" ---------- 739.029

Burlington, 0.8 mile east of, 165 feet east of T road south, 100 feet west of T road north, on northeast corner of cement bridge over small stream; chiseled square, marked "745.7" ---------- 745.66

Burlington, 1.9 miles east of, 2.2 miles west of (Moorefield) Junction, on east edge of T road north, in root of 12-inch oak tree; copper nail, marked "849.2" ---------- 849.11

Burlington, 2.8 miles east of, 1.3 miles west of (Moorefield) Junction, 30 feet east of T road north, 20 feet north of main road, 1 foot from fence, in top of old tree stump; copper nail, marked "838.2" ---------- 837.60

Burlington, 4.1 miles east of, 7 miles west of **Romney,** 560 feet east of store, at **(Moorefield) Junction,** on south edge of road, in top of mile-stone; bronze tablet stamped "W. VA. 1920 775"; reset in bridge ---------- 774.48

From (Moorefield) Junction southwest along highways to Moorefield Quadrangle.

(Moorefield) Junction, 1.3 miles southwest of, 40 feet north of wooden bridge, 60 feet north of T road west, on east edge of road, in root of 14-inch oak tree; copper nail, marked "804.6" ---------- 804.05

(Moorefield) Junction, 2.2 miles southwest of, 60 feet southeast of farm house, in southeast corner of cement bridge over small stream; chiseled square, marked "825.9" ---------- 825.32

(Moorefield) Junction, 3.1 miles southwest of, at T road west, in southeast corner of cement foundation of house; bronze tablet stamped "W. VA. 1920 842" ---------- 841.825

(Moorefield) Junction, 4.1 miles southwest of, 0.3 mile north of **Rada P. O.,** 2.8 miles north of **Purgitsville,** 20 feet west of road, in root of hickory tree; copper nail, marked "872.6" ---------- 872.04

(Moorefield) Junction, 5.0 miles southwest of, 0.6 mile south of **Rada P. O.,** 1.9 miles north of **Purgitsville,** 40 feet south of farm house, at fence line, 30 feet west of road, in root of large tree; copper nail, marked "881.7" ---------- 881.12

(Moorefield) Junction, 5.9 miles southwest of, 1.0 mile north of **Purgitsville,** in southwest corner of cement bridge over small stream, in top of guard-rail; bronze tablet stamped "W. VA. 906 1920" ---------- 905.368

From Moorefield Quadrangle northeast along Baltimore and Ohio Railroad (Petersburg Branch) to Hanging Rock Quadrangle.

Sector Station, 2.4 miles northeast of, 250 feet south of **Pancake** flag-stop, at southeast corner of bridge, in wooden support; copper nail, painted "722.6" ---------- 722.66

Vanderlip Station, 5.0 miles southwest of, 250 feet south of **Johnson** flag-stop, on west end of cement drain pipe; bronze tablet stamped "W. VA. 1920 715" ---------- 714.908

Vanderlip Station, 3.9 miles southwest of, 1.1 miles northeast of **Johnson** flag-stop, on west edge of track, on point of large boulder; chiseled square, painted "716.6" ---------- 716.60

Vanderlip Station, 3.1 miles southwest of, at **Hampshire Club** flag-stop, in front of stone house, in stone wall; bronze tablet stamped "W. VA. 1920 714" ---------- 714.072

Vanderlip Station, 2.0 miles southwest of, 1.1 miles northeast fill; chiseled square, painted "682.9" ---------- 682.86
of **Hampshire Club,** on east edge of track, in stone holding

Vanderlip Station, 0.9 mile southwest of, on west side of track, in wooden support at cattle-guard; copper nail, painted "684.5" ---------- 684.45

Vanderlip Station, 30 feet east of road crossing, 100 feet west of store, in end of timber, at railroad-switch; copper nail, painted "682.4" ---------- 681.78

Vanderlip, 0.4 mile northwest of, at northwest corner of wagon bridge over South Branch of Potomac River, on cement post of guard-rail; bronze tablet stamped "W. VA. 1920 677" ---------- 676.800

Vanderlip, 1.2 miles northeast of, in northeast corner of wooden support, at cattle-guard; copper nail, painted "679.0" ---------- 678.99

Romney Junction, 50 feet north of switch, on east edge of culvert No. 20, in wooden support; copper nail; painted "665.9" ---------- 665.90

From (Moorefield) Junction northeast along highways to Vanderlip Station, Baltimore and Ohio Railroad (Petersburg Branch), thence east to Hanging Rock Quadrangle.

(Moorefield) Junction, on south edge of road, in top of mile-stone; bronze tablet stamped "W. VA. 1920 775" ---------- 774.192

Vanderlip Station, 4.2 miles southwest of, 1.2 miles east of **(Moorefield) Junction,** 250 feet east of stone bridge over small stream, on south edge of road, in root of 10-inch tree; copper nail, marked "773.8" ---------- 773.22

Vanderlip Station, 3.4 miles southeast of, 2.0 miles east of **(Moorefield) Junction,** 120 feet north of creek, on east edge of road, in top of mile-stone; chiseled square, marked "763.0" ---------- 762.44

Vanderlip Station, 1.9 miles west of, 3.5 miles northeast of **(Moorefield) Junction,** at ford of Mill Creek, 150 feet south of house, 50 feet east of road, on east bank of creek, in ledge of rock; bronze tablet stamped "W. VA. 1920 722"-- 721.392

Vanderlip Station, 1.0 mile southwest of, 4.4 miles east of **(Moorefield) Junction,** 10 feet north of foot-bridge to T road south over Mill Creek, in boulder; chiseled square, marked "698.5" ---------- 697.94

Vanderlip Station, 30 feet east of railroad crossing, 100 feet west of store, in end of timber of railroad-switch; copper nail, marked "682.4" ---------- 681.78

Romney, 1.4 miles southwest of, at west end of cement bridge over South Branch of Potomac River, 0.4 mile east of **Vanderlip Station,** on top of south guard-rail of bridge; chiseled square, marked "677.7" ---------- 677.06

Primary leveling by E. E. Harris in 1921:

At Romney.

Romney, in north face near east corner of concrete foundation of First National Bank Building, diagonally across road from Court-House; bronze tablet stamped "H 1921 W. VA. Elev. ——" -- 827.829

Witness mark, 85.6 feet north of above P. B. M., in west root 24-inch maple tree; copper nail and washer ------------- 825.11

HANGING ROCK QUADRANGLE: HAMPSHIRE COUNTY.

(Latitude 39° 15'-39° 30'; Longitude 78° 30'-78° 45'.)

Third order leveling by F. L. Shalibo in 1920:

From Romney, Keyser Quadrangle, northeast along Baltimore and Ohio Railroad to Flintstone Quadrangle.

Romney Junction, 1.0 mile northeast of, on west edge of track, in base of telephone-pole; iron spike, marked "656.3"---- 656.25

Romney Junction, 1.9 miles northeast of, 1.3 miles southwest of **Wapocomo Station,** in foundation at northwest corner of Mr. Inskeep's residence; bronze tablet stamped "W. VA. 1920 668" -- 667.785

Romney Junction, 3.2 miles northeast of, at **Wapocomo Station,** 50 feet north of road crossing, on east edge of track, in ledge of rock; chiseled square, painted "649.8" ------ 649.74

Romney Junction, 4.0 miles northeast of, on northeast corner of bridge No. 16, 0.8 mile northeast of **Wapocomo Station,** in wooden support; copper nail, painted "665.7" --------- 665.66

Springfield Station, 3.0 miles southwest of, at southwest corner of east abutment of railroad bridge over South Branch of Potomac River; bronze tablet stamped "W. VA. 1920 634" -- 634.123

Springfield Station, 1.8 miles southwest of, at **Grace** flag-stop, in southwest corner of county road crossing, in base of telephone-pole; iron spike, (erroneously) painted "664.2" 644.07

Springfield Station, 0.7 mile southwest of, on west side of track, in base of telephone-pole 8/10; iron bolt, painted "727.5" -- 727.43

Springfield Station, at northwest corner of station, in top of stone foundation; bronze tablet stamped "W. VA. 1920 780" -- 779.973

Springfield Station, 1.3 miles northeast of, in northwest corner of second-class road crossing, in base of telephone-pole; iron spike, painted "818.5" --------------------------- 818.28

Springfield Station, 2.5 miles northeast of, at northwest corner of wooden bridge over small stream, in wooden foundation; copper nail, painted "744.0" -------------------- 743.83

Springfield Station, 3.2 miles northeast of, at county road crossing, on east side of track, in fence-post; iron spike, painted "694.2" -- 694.00

Green Spring, 3.7 miles southwest of, about 0.5 mile southwest of **Donaldson Station**, near Frank A. Dempsey's residence, 300 feet east of railroad, at spring-house, in cement curb; bronze tablet stamped "W. VA. 1920 638" -------------- 637.840

From near Romney southeast along highways in southwest part of Quadrangle to Wardensville Quadrangle.

Romney, 0.6 mile southeast of, on east edge of road, at northwest corner of barn, in small rock, chiseled square, marked "917.1" -- 916.50

Romney, 1.6 miles southeast of, at T road south to Fairview Church, 200 feet from school, near small wooden bridge, in boulder; chiseled square, marked "1021.9" ------------1,021.30

Romney, 2.0 miles southeast of, on Grassy Lick road, about 200 feet east of T road north, on small cement bridge over stream; chiseled square, marked "1113.3" --------------1,112.66

Romney, 3.2 miles southeast of, in south foundation of **Fairview Church**; bronze tablet stamped "W. VA. 1920 1578" --1,577.117

Romney, 4.1 miles southeast of, 30 feet southeast of stream crossing, at T road west to farm house, 40 feet west of road, in root of small tree; copper nail, marked "1357.3" --1,356.65

Romney, 5.0 miles southeast of, at road forks of T road west, 200 feet southeast of stream crossing, 30 feet west of road, in top of old stump; copper nail, marked "1222.3" ------1,221.64

Romney, 6.2 miles southeast of, 10 feet west of road, 100 feet south of farm house, in northeast corner of foundation of barn; bronze tablet stamped "W. VA. 1920 1322" --------1,321.114

Romney, 7.2 miles southeast of, 30 feet south of second-class road east, on east edge of road, 200 feet north of house, in large boulder; chiseled square, marked "1405.3" ------1,404.67

Romney, 8.1 miles southeast of, about 10 feet east of road, 30 feet from small ford in stream, in root of large oak tree; copper nail, marked "1496.1" ---------------------1,495.47

Romney, 8.7 miles southeast of, 11.0 miles north of **Inkerman**, at foot of long hill, on west side of road, near farm gate, in root of large tree; copper nail, marked "1568.2" ------1,567.51

Third order leveling by E. E. Harris in 1921:

From point east of Romney, Keyser Quadrangle, east along highways to Frenchburg, thence northeast to Cacapehon, Capon Bridge Quadrangle.

Romney, 2.37 miles east of, on west side of road, 80 feet south of lane to farm house southeast, on top of outcrop of rock, pole "T. B. M. 1259.9" ---------------------------------1,259.90
at base of cliff; chiseled square, marked on telephone-

Romney, 2.94 miles east of, in northwest corner of T road north, on top of rock culvert; chiseled square, marked on pole "1416.4" 1,416.41

Romney, 3.28 miles east of, in gap of mountain, in southwest corner of T road south, in north face 5.5 feet from east end of concrete foundation to large barn; bronze tablet stamped "H 1921 W. VA. Elevation 1463", marked on telephone-pole "P. B. M. 1463.3" 1,463.242

Reference mark, 92.5 feet N. 45° E. of above tablet, just west of **Ebenezer Church**, in west root of tree; copper nail and washer 1,461.24

Romney, 4.19 miles east by 0.79 mile west of **Shanks Post-Office**, on west edge of road just south of road forks, on top of outcrop of rock; chiseled square, marked "T. B. M. 1241.7" 1,241.72

Shanks Post-Office, in northwest corner of crossroads, in center of south edge of lower stone step at entrance to **Shanks Post-Office**; chiseled square, marked on telephone-pole "T. B. M. 1129.6" 1,129.63

Shanks Post-Office, 0.55 mile east by 0.98 mile west of **Frenchburg**, on north edge of road, 150 feet east of **Little Cacapon School**, in south root of 18-inch oak tree; copper nail and washer, marked "T. B. M. 1058.8" 1,058.76

Frenchburg, on north side of road, 98 feet west of store, 100 feet west of road forks, in center of north head-wall of concrete culvert; bronze tablet stamped "1010 H 1921 W. VA.", marked on telephone-pole "P. B. M. 1010.2" 1,010.161

Reference mark, 97.8 feet east of above tablet, in southwest corner of stone foundation of store occupied by E. B. Cummins; chiseled square 1,008.42

Frenchburg, 0.63 mile northeast of, on east side of road, 50 feet north of T road east, 2 feet inside fence line, in base on west side of telephone-pole; top of head of railway spike, marked on corner fence-post "T. B. M. 1014.8" 1,014.82

Frenchburg, 1.26 miles northeast of, on east side of road, opposite forks of road, in west root of large oak stump; copper nail and washer, marked on telephone-pole "T. B. M. 1003.4" 1,003.38

Frenchburg, 2.16 miles northeast of, on east edge of road, at sharp turn in road, in northeast corner of small wooden culvert; copper nail and washer, marked on fence "T. B. M. 999.3" 999.29

Frenchburg, 3.13 miles northeast of, 35 feet east by 35 feet south of T road east, about 300 feet west of **Millbrook School**, in top of stovepipe filled with concrete set in ground; bronze tablet stamped "925 H 1921 W. VA.", marked on mail-box post "P. B. M. 925.2" 925.154

Reference mark No. 1, near tablet, in north root of 10-inch tree; copper nail and washer 920.99

Reference mark No. 2, near tablet, in top of large rock outcrop; chiseled square ---------------------------------- 923.86

Frenchburg, 4.13 miles northeast of, on west edge of road, 250 feet north of deserted store building, in west root of 6-inch pine tree; copper nail and washer, marked on blazed tree "T. B. M. 943.1" --------------------------------- 943.08

Frenchburg, 4.70 miles northeast of, in southwest corner of crossroads, 2 feet north of corner fence-post, on top of flat ledge of rock flush with ground; chiseled square, post marked "T. B. M. 889.8" ------------------------------- 889.72

Frenchburg, 5.57 miles northeast by 4.01 miles southwest of **Higginsville**, in northeast corner of lane (forks of) to farm house, in west root of 15-inch sycamore tree; copper nail and washer, marked on blazed tree, "T. B. M. 848.7" 848.71

Higginsville, 2.60 miles southwest of, in southeast corner of forks of lane south through gate, in angle of fence line, in top of 6-inch stovepipe filled with concrete; bronze tablet stamped "H 1921 W. VA. Elev. 815", marked on corner fence-post "P. B. M. 814.7" -------------------- 814.726

Reference mark, 66.7 feet N. 60° W. of tablet, in north root of a 36-inch white oak tree; copper nail and washer -------- 815.12

Higginsville, 1.84 miles southwest of, on east edge of road, 100 feet northeast of abandoned school, 50 feet south of Duck Lick Run, in north root of 18-inch walnut tree; copper nail and washer, marked on blazed tree "T. B. M. 823.4" 823.34

Higginsville, 1.12 miles southwest of, in northeast corner of T road east, in west root of 10-inch hickory tree; copper nail and washer, marked on blazed tree "T. B. M. 787.3" 787.24

Higginsville, 250 feet east of post-office, on north side of road, 2 feet inside fence line, in line with T road south, in top of 6-inch stovepipe filled with concrete; bronze tablet stamped "H 1921 W. VA. Elev. 769", marked on fence "P. B. M. 769" -------------------------------------- 768.965

Reference mark, 47.7 feet N. 65° W. of tablet, in west root of 18-inch locust tree; copper nail and washer ------------ 769.53

Higginsville, 0.91 mile east of, on east edge of road, in line with T road west, about 150 feet north of school, in north root of forked white oak tree marking northwest corner of school property; copper nail and washer, tree blazed and marked "T. B. M. 785.6" ------------------------------- 785.57

Higginsville, 1.54 miles northeast by 0.71 mile southwest of **Creekvale**, on east edge of road, 100 feet south of angle in road, in west root of 15-inch oak tree; copper nail and washer, marked on blazed tree "T. B. M. 762.2" -------- 762.15

Creekvale, 150 feet northeast of post-office, on east side of road, opposite south end of large grass triangle, in forks of road, in northwest corner of pasture, in top of stovepipe filled with concrete; bronze tablet stamped "H 1921 W. VA. Elev. 728", tree blazed and marked "P. B. M. 727.9" -- 727.879

Reference mark, 37.2 feet N. 70° W. of tablet, in south end of large grass triangle in north root of 15-inch oak tree; copper nail and washer ---------- 727.38

Creekvale, 0.79 mile northeast of, on west edge of road, 30 feet north of small wooden bridge over drain, in east root of 30-inch oak tree; copper nail and washer, marked on blazed tree "T. B. M. 708.9" ---------- 708.83

Creekvale, 1.71 miles northeast of, 30 feet north of road center, on east side of cemetery, in south root of 30-inch oak tree; copper nail and washer, tree blazed and marked "T. B. M. 730.7" ---------- 730.65

Creekvale, 2.09 miles northeast of, on south side of road, just east of forks of road west to Levels, in west root of 24-inch oak tree; copper nail and washer, rock cliff marked "T. B. M. 682.1" ---------- 682.05

Creekvale, 2.71 miles northeast of, on east side of road, 200 feet northeast of dwelling, 15 feet south of barn, 2 feet east of fence, in top of 6-inch stovepipe filled with concrete; bronze tablet stamped "663 H 1921 W. VA.", fence marked "P. B. M. 663.1" ---------- 663.047

Reference mark, 133.7 feet N. 20° E. of tablet, on east edge of road, in west root of 24-inch oak tree; copper nail and washer ---------- 662.08

Creekvale, 3.50 miles northeast of, on west edge of road, opposite lane west through gate to sawmill, on south edge of drain, in west root of forked hickory tree; copper nail and washer, marked on fence "T. B. M. 673.1" ---------- 673.06

Creekvale, 4.25 miles northeast by 2.49 miles south of **Cacapehon,** in northeast corner of forks of road, in north root of 12-inch white oak tree; copper nail and washer, marked on blazed tree "T. B. M. 682" ---------- 681.91

Reference mark, 48 feet S. 30° E. of T. B. M., in top of large stump; copper nail and washer ---------- 685.23

Cacapehon, 1.5 miles south of, in northwest corner of forks of lane to residence of Herbert A. Abe, in angle of pasture fence, in top of concrete post; bronze tablet stamped "702 H 21 1921 W. VA.", marked on blazed tree "P. B. M. 702.5" ---------- 702.438

Reference mark, 29.4 feet south of above tablet, in east root of 10-inch sycamore tree ---------- 709.81

Cacapehon, 0.86 mile southwest of, on east edge of road, 30 feet south of mail-box, just north of lane through gate to dwelling, on top of outcrop of rock on bank of road; chiseled square, tree blazed and marked "T. B. M. 810.7" 810.62

From Frenchburg east along highways to Hanging Rock, thence south to Sedan, Wardensville Quadrangle.

Frenchburg, 1.00 mile southeast by 1.31 miles southwest of **Augusta,** on east edge of road, in line with forks of road west, on top of ledge of rock; chiseled square, marked "T. B. M. 1063.1" ----------1,063.05

Augusta, on north edge of road, in northeast corner of yard to residence of Jim Haines, in top of concrete post; bronze tablet stamped "H 23 1921 W. VA. Elev. 1299", marked on corner fence-post "U. S. B. M. 1299.3" ---------------- 1,299.205

Reference mark, 36.7 feet S. 70° W. of tablet, on lower stone step to residence of Jim Haines; chiseled square -------- 1,297.02

Augusta, 0.87 mile east of, on north edge of road, in northwest corner of wooden culvert; copper nail and washer, marked on fence "T. B. M. 1168.8" -------------------------- 1,168.74

Augusta, 1.33 miles east of, on north edge of road, 80 feet east of road forks, in south root of 24-inch oak tree; copper nail and washer, marked on blazed tree "T. B. M. 1172.8" -- 1,172.78

Augusta, 2.22 miles east by 0.85 mile west of **Pleasantdale Post-Office,** in southeast corner of crossroads just north of **Tearcoat Church,** in south root of 20-inch oak tree; copper nail and washer, marked on telephone-pole "T. B. M. 1043.3" -- 1,043.34

Pleasantdale Post-Office, 600 feet east of, in southeast corner of forks of private lane south, in northwest corner of pasture, in top of concrete post; bronze tablet stamped "H. 24 1921 W. VA. Elev. 1052", marked on fence "U. S. P. B. M. 1052.4" ------------------------------------ 1,052.395

Reference mark, 102.8 feet S. 45° E. of tablet, on top of flat boulder; chiseled square -------------------------------- 1,050.94

Pleasantdale Post-Office, 0.90 mile east of, on east edge of road, 100 feet south of forks of road to northeast, on top of ledge of rock; chiseled square, marked on base of mail-box post "T. B. M. 1102.2" ----------------------------- 1,102.19

Pleasantdale Post-Office, 1.31 miles east of, in northeast corner of parapet wall of concrete bridge over Pine Draft Run; chiseled square, marked "965.5" ----------------- 965.51

Pleasantdale Post-Office, 1.73 miles east by about 1.5 miles northwest of **Hanging Rock Post-Office,** on east edge of road, 100 feet south of dwelling, in west root of 30-inch oak tree; copper nail and washer, marked on tree "T. B. M. 1129.1" -- 1,129.10

Hanging Rock Post-Office, about 1.29 miles west of, 0.58 mile northwest of bridge over North River, on east edge of road, 30 feet south of gate to pasture, on top of 15-inch drain-pipe; chiseled square, marked on fence-post "T. B. M. 899.7" -- 899.74

Hanging Rock Post-Office, about 0.71 mile east of, at bridge over North River, in east end of north retaining wall; chiseled square, marked "U. S. 883.3" ---------------- 883.36

Water under above bridge --------------------------------- 867

Hanging Rock Post-Office, about 0.5 mile west of, on south side of road near road forks, in northeast corner of front yard to home of J. C. Rogers, in top of concrete post; bronze tablet stamped "H 25 1921 W. VA.", marked on telephone-pole "U. S. P. B. M. 888.1" ---------------------------- 888.078

Reference mark, 92.2 feet S. 20° E. of tablet, in north root of 4-foot sycamore tree; copper nail and washer ------------ 887.74

Hanging Rock, about 0.5 mile west by 0.62 mile south of, 2.88 miles north of **Sedan**, on east edge of road, in front of house, in top of large stump; copper nail and washer, marked on stump "T. B. M. 968.1" --------------------- 968.14

Sedan, 1.84 miles north of, on west side of angle in road, on south side of private lane north to farm house, in east root of 4-foot oak tree; copper nail and washer, marked on blazed tree "T. B. M. 938.3" ---------------------------- 938.37

From Hanging Rock north along highways to North River Mills, Capon Bridge Quadrangle.

Hanging Rock, 0.5 mile west by 1.01 miles north of, on south edge of road, in east root of 30-inch oak tree; copper nail and washer, marked on tree "T. B. M. 882.1" ----------- 882.12

Hanging Rock, 0.5 mile west by 1.77 miles north of, on west edge of road and south edge of lane west to house, in west root of 12-inch walnut tree; copper nail and washer, marked on tree "T. B. M. 925.5" ---------------------- 925.47

Hanging Rock, 0.5 mile west by 2.74 miles north of, by 4.76 miles south of **North River Mills**, on west edge of road, at forks of road, in top of concrete post; bronze tablet stamped "H 31 1921 W. VA. Elev. 878", marked on fence "P. B. M. 877.8" -- 877.789

Reference mark, 44.3 feet S. 65° E. of tablet, in center of large triangle formed by roads in three directions, in south root of 25-inch oak tree; copper nail and washer ------------ 880.04

North River Mills, 4.07 miles south of, on west edge of road, in angle of road in west root of 18-inch walnut tree; copper nail and washer, marked on tree "T. B. M. 863.4"---- 863.42

North River Mills, 3.30 miles south of, on east edge of road, 60 feet south of point where road forks North River, in root of tree; copper nail and washer, marked on fence-post "T. B. M. 827.8" --------------------------------------- 827.81

North River Mills, 2.62 miles south of, on east edge of road, 70 feet south of point where road forks North River, just east of sycamore tree, on top of stump; copper nail and washer, marked on blazed tree "T. B. M. 823.5" -------- 823.52

North River Mills, 1.36 miles south of, on east edge of road, 10 feet west of gate to pasture across road from home of Ed. Loy, in angle of fence, in top of concrete post; bronze tablet stamped "869 H 32 1921 W. VA.", marked on fence-post "P. B. M. 869.2" --------------------------------------- 869.170

Reference mark, 84.6 feet N. 35° E. of tablet, on top of boulder; chiseled square -- 870.86

North River Mills, 0.48 mile south of, on east edge of road, 150 feet north of low gap, in east root of 18-inch walnut tree; copper nail and washer, marked on blazed tree "T. B. M. 979.7" -- 979.64

North River Mills, about 200 feet east of post-office, on north edge of road, at road forks, in front of home of Wm. Miller, in south root of 24-inch poplar tree; copper nail and washer, marked on fence "T. B. M. 812.5" ----------- 812.25

From point northwest of Forks of Cacapon, Capon Bridge Quadrangle, northwest along highways to point southwest of Cacapehon.

Forks of Cacapon, 6.42 miles west of, in northeast corner of crossroads, north to Cacapehon Post-Office and road south to Spring Gap Post-Office, inside fence line, in top of concrete post; bronze tablet stamped "H 38 1921 W. VA. Elev. 1294" --1,294.154

Reference mark, 39.8 feet N. 45° W. of tablet, in northwest corner of crossroads, on boulder; chiseled square ------1,291.66

Forks of Cacapon, 6.95 miles west of, on east edge of road, in line with lane west, in west root of 20-inch oak tree; copper nail and washer, marked on blazed tree "T. B. M. 1100.3" --- 1,100.18

Forks of Cacapon, 7.90 miles west of, 150 feet east of **Dug Hill School,** on east bank of Dug Hill Run, on south edge of road, in north root of 10-inch oak tree; copper nail and washer, tree marked "T. B. M. 746.2" ----------------- 746.11

CAPON BRIDGE QUADRANGLE: HAMPSHIRE AND MORGAN COUNTIES.

(Latitude 39° 15′-39° 30′; Longitude 78° 15′-78° 30′).

Third order leveling by E. E. Harris in 1921:

From Hanging Rock Quadrangle along highways northeast across northwest corner of Quadrangle into Paw Paw Quadrangle.

Cacapehon, 0.86 mile southwest of, on east edge of road, 30 feet south of mail-box, just north of lane through gate to dwelling, on top of outcrop of rock on bank of road; chiseled square, tree blazed and marked "T. B. M. 810.7"----- 810.62

Cacapehon Post-Office, about 70 feet northeast of, on north edge of road, in top of concrete base to spring-house; bronze tablet stamped "H 22 1921 W. VA. Elev. 708", "P. B. M. 708.2" marked ------------------------------------ 708.120

Reference bench mark, in north root of tree, in angle of fence, 113.4 feet west of tablet; copper nail and washer ------- 698.38

Cacapehon, 0.42 mile north by 2.24 miles south of **Little Cacapon,** on west edge of road, 60 feet south of forks of road west, on top of rock boulder; chiseled square, "T. B. M. 644.8" marked on base of mail-box post ---------------- 644.69

From North River Mills, Hanging Rock Quadrangle, along highway east to Cold Stream, thence north to Forks of Cacapon, thence northwest into Hanging Rock Quadrangle.

North River Mills, 0.73 mile east of, on north edge of road, 400 feet east of ruins of an old mill, in west root of 30-inch oak tree; copper nail and washer, tree blazed and marked "T. B. M. 902.6" -- 902.57

North River Mills, 1.11 miles east of, in southeast corner of lane through gate to farm house, in corner of pasture, in top of concrete post; bronze tablet stamped "H 33 1921 W. Va. Elev. 1003", gate-post marked "P. B. M. 1,002.8"---1,002.726

Reference bench mark, on top of outcrop of rock, 41.4 feet N. 55° E. of tablet; chiseled square ----------------------1,003.70

North River Mills, 1.59 miles east of, on north edge of road, 30 feet west of road forks, on top of large boulder; chiseled square, "T. B. M. 1,161.6" marked on telephone-pole------1,161.49

North River Mills, 2.18 miles east of, on east edge of road, at road forks, 200 feet north of stream crossing, on top of flat boulder; chiseled square, "T. B. M. 1,187.9" marked on fence ---1,187.82

Cold Stream, 1.43 miles west of, on south side of road west of gap, on top of ledge of rock; chiseled square, ledge marked "T. B. M. 1,373.1" -----------------------------1,373.00

Cold Stream, 0.56 mile west of, on west edge of road, opposite forks of road northeast, inside of fence line, set in top of concrete post; bronze tablet stamped "H 34 1921 W. Va. 1094", "P. B. M. 1,094.4" marked on gate-post ----------1,094.366

Reference bench mark, on top of large boulder, in forks of road, 49.8 feet north of above tablet; chiseled square----1,098.52

Cold Stream, 0.56 mile west by 0.85 mile north of, 4.43 miles south of **Forks of Cacapon,** on east edge of road, 70 feet north of road forks, in west root of 30-inch elm tree; copper nail and washer "T. B. M. 1,155.8" marked on tree----1,155.73

Forks of Cacapon, 3.40 miles south of, on west edge of road, in east root of 18-inch elm tree; copper nail and washer, "T. B. M. 1,361.6" marked on tree ----------------------1,361.44

Forks of Cacapon, 2.88 miles south of, on north edge of road, at east end of drive out in roadway, set in top of concrete post; bronze tablet stamped "H 35 1921 W. Va. Elev. 1285", tree marked "P. B. M. 1,284.8" ------------------1,284.658

Reference bench mark, in east root of 10-inch elm tree, 17.2 feet S. 40° W. of tablet; copper nail and washer---------1,284.11

Forks of Cacapon, 2.15 miles south of, in northeast corner of crossroads, in west root of 10-inch oak tree; copper nail and washer, tree blazed and marked "T. B. M. 946.4"---- 946.34

Forks of Cacapon, 1.45 miles south of, on west edge of road, north side of drain, just west of an abandoned house, in bottom, in south root of 20-inch oak tree; copper nail and washer, "T. B. M. 757.3" marked on tree 757.24

Forks of Cacapon, 0.50 mile east of, at concrete bridge over North River, in east end of north parapet wall; chiseled square, wall marked "T. B. M. 682.8" 682.76

Surface of water under above bridge at 5 p. m., May 26, 1921.. 680.

Forks of Cacapon, in northwest corner of forks of T road north across road from building, formerly post-office, inside fence line, set in top of concrete post; bronze tablet stamped "H 36 1921 W. Va. Elev. 718", "P. B. M. 718.5" marked on fence 718.376

Reference bench mark, in west root of 24-inch oak tree, 24.2 feet S. 15° W. of tablet; copper nail and washer 718.37

Forks of Cacapon, 0.80 mile west of, on north edge of road, in south root of 22-inch oak tree; copper nail and washer, "T. B. M. 906.3" marked on blazed tree 906.72

Forks of Cacapon, 1.64 miles west of, on west edge of road, 50 feet south of dim road to east, in east root of 15-inch oak tree; copper nail and washer, tree blazed and marked "T. B. M. 1,082.6" 1,082.55

Forks of Cacapon, 2.42 miles west of, in northwest corner of road forks, in south root of 15-inch elm tree; copper nail and washer, "T. B. M. 1,152.2" marked on tree 1,151.07

Forks of Cacapon, 3.08 miles west of, in center of grass triangle formed by roads in three directions, on top of flat rock flush with ground; chiseled square, tree marked "T. B. M. 960.9" 960.82

Forks of Cacapon, 3.83 miles west of, in northeast corner of T road north, in top of large boulder; bronze tablet stamped "1061 H 37 1921 W. Va.", boulder marked "P. B. M. 1,060.6" 1,060.519

Reference bench mark, on large boulder, 36.7 feet N. 30° W. of tablet; chiseled square 1,063.86

Forks of Cacapon, 4.61 miles west by 1.15 miles east of top of **Spring Gap Mountain,** at forks of T road west, at southeast corner of bridge; copper nail and washer, "T. B. M. 1,293.5" marked on tree 1,293.42

Forks of Cacapon, 5.76 miles west of, just east of top of **Spring Gap Mountain,** on south side of road, in east root of [illegible]-inch oak tree; copper nail and washer, tree marked "[illegible] M. 1,583.7" 1,583.53

Forks of Cacapon, 6.42 miles west of, in southeast corner of crossroads, road north to Cacapehon Post-Office and road south to Spring Gap Post-Office, inside fence line, set in top of concrete post; bronze tablet stamped "H 37 1921 W. Va. Elev. 1294", corner fence-post marked "P. B. M. 1,294.3" (in Hanging Rock Quadrangle) 1.294.154

Reference bench mark, in northwest corner of crossroads, on boulder and 39.8 feet N. 45° W. of tablet; chiseled square 1,291.66

From Forks of Cacapon northeast along highway to a point south of Fisher Ford in Paw Paw Quadrangle.

Forks of Cacapon, 0.97 mile north of, on west edge of road, on north edge of lane west through gate to sawmill, on top of large oak stump; copper nail and washer, "T. B. M. 721.8" marked on stump ---------------------------- 721.73

Forks of Cacapon, 1.62 miles north of, on west edge of road, 60 feet north of road forks, in east root of 10-inch oak tree; copper nail and washer, tree marked "U. S. 835.3 B. M." -- 835.13

Forks of Cacapon, 2.36 miles north of, on east edge of road, north edge of trail, east along timber line, in south root of 12-inch oak tree; copper nail and washer, tree marked "U. S. 890 B. M." ---------------------------------- 889.82

Forks of Cacapon, 3.47 miles north of, on south edge of road, 100 feet west of right-angle turn in road, on ledge of rock; bronze tablet stamped "629 H 40 1921 W. Va.", "P. B. M. 629" marked on ledge ---------------------------------- 628.908

Reference bench mark, in east root of 25-inch locust tree, 29.8 feet N. 20° E. of tablet; copper nail and washer -------- 626.19

Forks of Cacapon, 4.24 miles north of, on west edge of road, 40 feet north of road forks, on rock ledge; chiseled square, "U. S. 601 B. M.", marked on ledge ------------------ 600.97

Forks of Cacapon, 5.07 miles north of, 50 feet west of road center, on north bank of road following Critton Run, in east root of 18-inch poplar tree; copper nail and washer, tree marked "U. S. 615.8 B. M." ---------------------------- 615.60

Forks of Cacapon, 5.75 miles north by 2.61 miles south of **Largent**, in low gap of mountain, on east edge of road, in northwest corner of yard around **Eubulus Church**, in top of concrete post; bronze tablet stamped "834 H 41 1921 W. Va.", "U. S. 834.2 B. M." marked on tree -------------- 833.982

Reference bench mark, in west root of 19-inch oak tree, 19.2 feet N. 25° E. of tablet; copper nail and washer ---------- 832.82

Largent, 1.76 miles south of, on east edge of road, 150 feet north of ford, in west root of 12-inch cedar tree; copper nail and washer, "U. S. 573.2 B. M." marked on tree------ 573.04

Surface of water at above-described ford "560" marked, at 12 M. June 1, 1921 ------------------------------------ 560.

Largent, 0.88 mile south of, on north edge of road, in south root of 25-inch maple tree; copper nail and washer, "U. S. 572 B. M." marked on tree ---------------------------- 571.81

Largent, 300 feet southeast of post-office, on north edge of road, at road forks, set in top of concrete post; bronze tablet stamped "587 H 42 1921 W. Va.", "U. S. 587.7 B. M." marked on tree ------------------------------------ 587.479

Reference bench mark, in north root of 40-inch locust tree, 34.2 feet S. 40° E. of tablet; copper nail with washer -------- 588.72

Largent, 0.62 mile north of, on west edge of road, 50 feet northeast of **Enon School**, in south root of 36-inch oak tree; copper nail and washer, "U. S. 711.8 B. M." marked on tree-- 711.58

Largent, 1.64 miles north of, on west edge of road, north edge of road west, in south root of 10-inch poplar tree; copper nail and washer, "U. S. 607.8 B. M." marked on tree ---- 607.59

Third order leveling by E. E. Harris in 1921:

From point 0.56 mile west of Cold Stream along highways south into Middletown Quadrangle.

Cold Stream Post-Office, 0.56 mile west of, on west edge of road, opposite forks of road north over Pine Mountain, inside fence line, in top of concrete post; bronze tablet stamped "1094 H 34 1921 W. Va.", gate-post marked "P. B. M. 1,094.4" --1,094.366

Reference bench mark, on top of large boulder, in forks of road, 49.8 feet north of above tablet; chiseled square----1,098.52

Cold Stream Post-Office, center of road, in front of ---------- 871.2

Cold Stream Post-Office, 0.15 mile east of, on south edge of road and west edge of road south, on top of large boulder; chiseled square, boulder marked "U. S. 833.7 B. M." ------ 833.65

Cold Stream Post-Office, 0.97 mile southeast of, on east edge of road, in front of store of J. W. Hutchinson, on top of large boulder; chiseled square, fence marked "U. S. 775.5 B. M." -- 775.42

Cold Stream Post-Office, 2.23 miles southeast of by 1.92 miles north of **Capon Bridge**, on west side of road and south side of lane west through gate, in top of concrete post; bronze tablet stamped "820 H 43 1921 W. Va.", gate-post marked "U. S. 819.7 B. M." ------------------------------------ 819.614

Reference bench mark, on top of outcrop of rock, 79.7 feet S. 25° W. of above P. B. M.; chiseled square ----------- 820.78

Capon Bridge, 1.05 miles north of, on west edge of road, in low gap, in east root of 24-inch oak tree; copper nail and washer, tree marked "U. S. 942.9 B. M." --------------- 942.89

Capon Bridge, just south of post-office, in southwest corner of top stone step at entrance to **Disciple Church**; bronze tablet stamped "819 H 44 1921 W. Va." ------------------- 818.766

Reference bench mark, 33.8 feet N. 20° W. of tablet, in northwest corner of concrete walk to church; chiseled square-- 816.98

Capon Bridge, 1.02 miles southwest of, on east edge of road, 20 feet south of forks of dim road to river, on top of large boulder; chiseled square, marked "U. S. 824.6 B. M."----- 824.54

Capon Bridge, 1.79 miles southwest of, on west edge of road, at forks of second-class road, in east root of 30-inch oak tree; copper nail and washer, tree marked "U. S. 804.4 B. M." --- 804.38

Capon Bridge, 2.63 miles southwest of, on north edge of road, edge of driveway to barn, in corner of pasture, in top of concrete post; bronze tablet stamped "811 H 45 1921 W. Va.", gate-post marked "U. S. 811.4 B. M." ---------- 811.354

Reference bench mark, in east root of 20-inch sycamore tree, 83 feet S. 50° W. of tablet; copper nail and washer ------ 806.35

Capon Bridge, 3.50 miles southwest of, on south edge of road, 100 feet west of road forks, in north root of 24-inch shell-bark tree; copper nail and washer, tree marked "U. S. 818.2 B. M." ---------- 818.20

MIDDLETOWN QUADRANGLE: HAMPSHIRE COUNTY.

(Latitude 39°-39° 15'; Longitude 78° 15'-78° 30'.)

Third order leveling by E. E. Harris in 1921:

From Capon Bridge Quadrangle southwest along highways in northwest part of Quadrangle into Wardensville Quadrangle.

Capon Bridge, 4.59 miles southwest of, on east edge of road, 100 feet south of T road east to Hooks Mills, in west root of 18-inch locust tree; copper nail and washer, tree marked "U. S. 870.4 B. M." ---------- 870.37

Capon Bridge, 5.55 miles southwest of, on east edge of road, just south of timber line, in west root of 36-inch oak tree; copper nail and washer, tree marked "U. S. 851.8 B. M."-- 851.74

Capon Bridge, 5.87 miles southwest of, on west edge of road, in sharp turn of and south side of lane west, in corner of field, set in top of concrete post; bronze tablet stamped "850 H 46 1921 W. Va.", fence marked "U. S. 850.4 B. M."- 850.355

Reference bench mark, 18 feet S. 60° E. of tablet, on boulder; chiseled square ---------- 845.50

Capon Bridge, 6.48 miles southwest of, 3.78 miles northeast of **Yellow Springs**, 40 feet east of road center, 30 feet north of road crossing river, in top of large stump; copper nail and washer, fence marked "U. S. 847.1 B. M." ---------- 847.11

Yellow Springs, 3.12 miles northeast of, on east edge of road, in line with T lane west to dwelling, 100 feet south of lane to river, in south root of 18-inch maple tree; copper nail and washer, fence marked "U. S. 858.2 B. M." ---------- 858.20

Yellow Springs, 2.31 miles northeast of, on north edge of road, 20 feet west of lane to dwelling, on top of large boulder; chiseled square, boulder marked "U. S. 871.7 B. M." ----- 871.69

GREENLAND GAP QUADRANGLE: GRANT AND HARDY COUNTIES.

(Latitude 39°-39° 15′; Longitude 79°-79° 15′.)

Third order leveling by Walter McCrea in 1919 and R. S. Stevenson in 1920:

From near northwest corner of Quadrangle southeast along highways to Scherr.

Mount Storm, 2.1 miles south of, 250 feet north of private road, west side of road, in root of large white oak tree, marked "T. B. M. 3,000"; copper nail and washer ---------------2,999.56

Mount Storm, 3.2 miles south of, 10 feet north of small culvert, 10 feet west of road, in large boulder; bronze tablet stamped "2,884 W. Va." ---------------2,883.481

Mount Storm, 4.0 miles south of, 300 feet north of dwelling house, 5 feet west of road, in large rock; chiseled cross mark, marked "T. B. M. 2,879" ---------------2,878.87

Mount Storm, 5.1 miles south of, 90 feet south of watering-trough, in large boulder, west side of road; chiseled square, marked "T. B. M. 2,819" ---------------2,820.57

Mount Storm, 6.5 miles south of, 130 feet south of turn in road, in ledge of rocks, north side of road; bronze tablet stamped "2,262 W. Va." ---------------2,261.028

Mount Storm, 7.4 miles south of, 125 feet west of gate to private road, south side of road in rock; chiseled cross mark, marked "T. B. M. 1,889" ---------------1,888.48

Scherr, west end of north abutment of concrete bridge over Elk Lick Run; chiseled square, marked "T. B. M. 1,551"--1,550.28

Third order leveling by F. L. Shalibo and Walter McCrea in 1919:

From Scherr along highways east to Williamsport thence northeast to northeast corner of Quadrangle. Leveled twice.

Greenland, in stone step of post-office; bronze tablet stamped "1,514 W. Va." ---------------1,513.662

Greenland, 1 mile southeast of, 1,800 feet south of iron bridge, in large flat rock, 5 feet west of road; chiseled cross mark, marked "T. B. M. 1,391" ---------------1,389.83

Greenland, 2.0 miles southeast of, 40 feet north of spring, 20 feet west of road, on pointed rock; chiseled cross mark, marked "T. B. M. 1,275" ---------------1,274.68

Falls, 50 feet north of post-office, 10 feet south of crossroads, in small rock; chiseled cross mark, "T. B. M. 1,257" painted on fence ---------------1,255.95

Falls Post-Office, 300 feet northeast of, iron bridge over North Fork of Patterson Creek, north side of east abutment; bronze tablet stamped "1,241 W. Va." ---------------1,239.933

Falls Post-Office, 0.8 mile northeast of, 15 feet southeast of road, 5 feet west of large oak tree, in small boulder; chiseled square, painted "1,224.4" ---------- 1,223.65

Falls Post-Office, 1.6 miles northeast of, opposite T road north, 40 feet from road, near gate to field, in root of large oak tree; copper nail, painted "1,193.1" ---------- 1,192.33

Falls Post-Office, 2.7 miles northeast of, opposite George Reeve's residence, 15 feet northwest of road, in small boulder; bronze tablet stamped "W. Va. 1,129" ---------- 1,128.656

Falls Post-Office, 3.5 miles northeast of, on north edge of road, at small stream crossing, in end of log, at bottom of rail fence; copper nail, painted "1,062.5" ---------- 1,061.74

Falls Post-Office, 4.4 miles northeast of, on northwest corner of wooden bridge, in support; copper nail, painted "1,034.9" ---------- 1,034.13

Williamsport, 0.9 mile southwest of, on north end of east abutment of iron bridge over Patterson Creek; bronze tablet stamped "W. Va. 981" ---------- 980.442

Williamsport, 150 feet north of post-office, on west edge of road, on south edge of stream crossing, 60 feet south of T road east, in small rock; chiseled square, painted "1,031.6" ---------- 1,030.78

Williamsport, 0.8 mile north of, in southwest corner of T road west, in gate-post, at corner of fence; iron spike, painted "977.0" ---------- 976.13

Williamsport, 1.8 miles north of, at top of hill, 150 feet north of Krous farm house, 70 feet west of road, in large boulder; bronze tablet stamped "W. Va. 970" ---------- 969.414

Williamsport, 2.7 miles north of, opposite driveway to D. C. Lyon's residence, 40 feet east of road, near gate to field, in large boulder; chiseled square, painted "955.6" ---------- 954.69

Williamsport, 3.8 miles north of, on northwest end of iron bridge over Patterson Creek, on west abutment of bridge; chiseled square, painted "860.5" ---------- 859.51

Leveling by Walter McCrea in 1919:

From Scherr southwest along highway to west border of Quadrangle.*

Scherr, west end of north abutment of concrete bridge over Elk Lick Run; chiseled square, marked "T. B. M. 1,551" ---------- 1,550.28

Scherr, 1.1 miles south of, 5 feet east of road, in large boulder; chiseled cross mark, marked "T. B. M. 1,707" ---------- 1,706.40

Scherr, 2 miles south of, 5 feet east of road, in root of black oak tree; copper nail and washer, marked "U. S. G. S. W. Va. T. B. M. 1,891" ---------- 1,889.86

*An error of 0.6 foot is adjusted in this line between Scherr across Davis Quadrangle to Hopeville, Onego Quadrangle. Line should be releveled.

Scherr, 3 miles south of, 120 feet south of J. W. Davis's dwelling house, west side of road, in large flat rock; bronze tablet stamped "1,820 W. Va." ---------- 1,819.409

Scherr, 4.0 miles south of, 50 feet north of small culvert, 10 feet east of road, in root of white oak tree; copper nail and washer, marked "T. B. M. 1,692" ---------- 1,691.04

Scherr, 4.9 miles south of, in southwest corner of concrete steps to brick church, east side of road; chiseled square, marked "T. B. M. 1,564" ---------- 1,563.52

Scherr, 6.6 miles south of, 150 feet south of gate leading to small dwelling house, in large rock, east side of road; bronze tablet stamped "1,664 W. Va." ---------- 1,664.038

Scherr, 7.7 miles south of, 2,500 feet south of schoolhouse, 10 feet east of road, in root of large oak tree; copper nail and washer, painted "T. B. M. 1,810" ---------- 1,809.06

Scherr, 8.6 miles south of, at intersection of roads, west side, in root of large white oak tree; copper nail and washer, marked "T. B. M. 1,718" ---------- 1,717.97

Scherr, 9.6 miles south of, 2,405 feet west of **Streby Post-Office**, 75 feet east of **Burgess Schoolhouse**, 5 feet west of road, in large flat rock; bronze tablet stamped "1,742 W. Va."-- 1,741.957

Scherr, 10.6 miles south of, 65 feet south of small culvert, 10 feet north of woods road, east side of road, in rock; chiseled cross, marked "T. B. M. 1,929" ---------- 1,928.23

Primary leveling by F. L. Shalibo in 1919:

From Williamsport southwest along highways to Petersburg, Petersburg Quadrangle.

Williamsport, 0.9 mile southwest of, on north end of east abutment of iron bridge over Patterson Creek; bronze tablet stamped "W. Va. 981" ---------- 980.442

Williamsport, 1.9 miles southwest of, 0.6 mile northeast of **Medley**, on west edge of road, in base of 16-inch ash tree; iron spike, painted "1,038.4" ---------- 1,037.60

Medley, in northwest corner of concrete bridge over Middle Fork, in base of bridge rail; chiseled square, painted "1,042.5" ---------- 1,041.66

Medley, 0.8 mile southwest of, in front of T. W. Michael's residence, in cement block at gate, on west edge of road; chiseled square, painted "1,064.6" ---------- 1,063.81

Medley, 1.8 miles southwest of, at T road west, in front of Earnest Naedele's residence, in cement block at gate; bronze tablet stamped "W. Va. 1,108" ---------- 1,107.268

Forman, at northeast corner of store, in root of large tree; copper nail, painted "1,116.8" ---------- 1,115.98

Lahmansville, in southeast corner of T road east, in front of Snyder Garage, in root of hickory tree; copper nail, painted "1,137.0" ---------- 1,136.20

Lahmansville, 1.5 miles southwest of, at top of divide, in southwest corner of road crossing, at northwest corner of Seymour Snyder's Garage in cement foundation; bronze tablet stamped "W. Va. 1,338" ---------------------------- 1,336.712

Lahmansville, 2.5 miles southwest of, at town of **Old Arthur,** 150 feet south of T road east, on west end of small stone culvert, in old log; copper nail, painted "1,149.5" -------- 1,148.72

Lahmansville, 3.8 miles southwest of, opposite T road east, at small stream crossing, on west side of fence, in root of willow tree; copper nail, painted "1,096.0" ------------ 1,095.19

Lahmansville, 4.1 miles southwest of, 300 feet south of **Mount Carmel Church,** in south end of stone steps to **Brushy Run School;** bronze tablet stamped, "1,112" ---------------- 1,111.526

Arthur, 250 feet south of Rhinehart store, in center of road forks, in root of two-foot oak tree; copper nail, painted "1,070.2" -- 1,069.44

Seymourville, 250 feet north of store, in southeast corner of bridge over Brushy Run, in wooden support; copper nail, painted "1,028.5" ------------------------------------ 1,027.66

Seymourville, 1.1 miles southwest of, at west end of bridge over Lunice Creek, in south abutment; bronze tablet stamped "W. Va. 1,008" ------------------------------- 1,006.724

Petersburg, 3.2 miles north of, on northwest corner of small concrete bridge; chiseled square, painted "990.1" -------- 989.27

Petersburg, 2.3 miles north of, on east edge of road, in root of large tree; copper nail, painted "977.3" --------------- 976.47

Petersburg, 1.1 miles north of, opposite T road west, in top of fence support stake; copper nail, painted "1,024.2" ------ 1,023.40

From Forman east along highway to east border of Quadrangle. (Line enters Moorefield Quadrangle.)

Forman, at northeast corner of store, in root of large tree; copper nail, painted "1,116.8" ------------------------- 1,115.98

Forman, 1.0 mile east of, 70 feet west of gate to mountain cabin, on north edge of road, in root of large tree; copper nail, painted "1,360.4" ----------------------------- 1,359.64

Forman, 2.1 miles east of, at top of mountain, in front of log cabin, on north edge of road, north side of fence, in root of apple tree; copper nail, painted "1,758.2" --------------- 1,757.35

Forman, 3.0 miles east of, at second-class T road northeast, 10 feet north of east gate-post, in ledge of rock; bronze tablet stamped "W. Va. 1,711" ------------------------------- 1,710.170

Forman, 3.7 miles northeast of, on second-class road, 100 feet northeast of T road northwest, on west edge of road, in root of large ash tree; copper nail, painted "1,568.7" ---- 1,567.92

Forman, 4.5 miles northeast of, on second-class road, opposite T road north, 15 feet south of road, in root of 16-inch maple tree; copper nail, painted "1,441.2" --------------- 1,440.42

From west border of Moorefield Quadrangle southwest and west along Baltimore and Ohio Railroad to Petersburg. Line leaves Moorefield Quadrangle and jogs into Petersburg Quadrangle.

Moorefield, 4.0 miles south of, on Baltimore and Ohio Railroad, on northwest corner of bridge No. 574, in wooden support; copper nail, painted "838.8" ---------------------------- 837.88

Moorefield, 5.2 miles south of, on Baltimore and Ohio Railroad, 120 feet north of bridge No. 577, in wooden support at cattle-guard, on east edge of track; copper nail, painted "853.3" -- 852.32

Petersburg, 3.6 miles east of, 20 feet south of track, at farm road crossing, in base of telephone-pole; iron spike, painted "894.9" --------------------------------------- 893.89

Welton Station, Baltimore and Ohio Railroad, on east railroad-tie, at switch-lever; copper nail, painted "902.0" -------- 900.99

Primary leveling by Walter McCrea in 1919:

From point 5.2 miles east of Hopeville east along highways near south border of Quadrangle to near Petersburg.

Hopeville, 5.2 miles east of, north side of road, in front of W. H. Kile's dwelling, in concrete walk; bronze tablet stamped "1,122 W. Va." ---------------------------------1,121.941

Hopeville, 6.1 miles east of, at intersection of roads, north side, in rock; chiseled cross mark, marked "T. B. M. 1,034"---1,033.86

Hopeville, 7.1 miles east of, 200 feet east of private road leading to north, 5 feet south of road, in root of oak tree; copper nail and washer, tree marked "T. B. M. 998" -------- 997.62

Hopeville, 8.0 miles east of, 0.5 mile west of Patterson Creek road, on North Fork turnpike, south of road, in root of hickory tree; copper nail and washer, tree marked "T. B. M. 1,086" --1,085.40

Petersburg, 1.1 miles north of, opposite T road west, in top of fence support stake; copper nail and washer, post marked "1,024.2 T. B. M." --------------------------------------1,023.40

MOOREFIELD QUADRANGLE: HAMPSHIRE AND HARDY COUNTIES.

(Latitude 39°-39° 15′; Longitude 78° 45′-79°.)

Primary leveling by F. L. Shalibo in 1919:

From west boundary 7.1 miles northwest of Moorefield southeast along highways to Moorefield thence south and southwest along Baltimore and Ohio Railroad to west border of Quadrangle.

Forman, 5.7 miles east of, on second-class road, 100 feet west of Stillhouse Run, in front of west of Powell's residence, near fence, in large rock; bronze tablet stamped "W. Va. 1151" ---1,149.88

Forman, 6.3 miles northeast of, on second-class road, 2.5 miles west of pike, 60 feet west of gate, in root of large tree; copper nail, painted "1,019.8" ---------------------------1,018.99

Forman, 7.0 miles northeast of, on second-class road, 1.8 miles west of pike, in cement base of north gate-post; chiseled square, painted "949.7" --------------------------------- 948.83

Forman, 7.9 miles northeast of, on second-class road, 0.9 mile west of pike, near small stream crossing, in root of sycamore tree; copper nail, painted "859.1" ---------------- 858.20

Moorefield, 4.5 miles north of, 200 feet north of McNeill's residence, in top at south end of west rail of cement bridge; bronze tablet stamped "W. Va. 791" ------------------- 790.069

Moorefield, about 3.1 miles north of, at west end of bridge over South Branch of Potomac River, on north abutment; chiseled square, painted "798.8" ---------------------- 797.96

Moorefield, 1.6 miles north of, on Baltimore and Ohio Railroad, at second-class road crossing, on west edge of track, in base of telephone-pole; iron spike, painted "803.9"------- 803.00

Moorefield, 0.7 mile north of, on Baltimore and Ohio Railroad, on west support of cattle-guard; copper nail, painted "802.4" --- 801.54

Moorefield, 50 feet southwest of railroad station, 10 feet west of track, 10 feet south of highway, at northeast corner of Piedmont Grocery store, in cement step; bronze tablet stamped "W. Va. 821" -------------------------------- 820.195

Moorefield, 0.9 mile south of, on Baltimore and Ohio Railroad, at west end of long trestle over Moorefield River, on north end of cement abutment; chiseled square, painted "821.5" --- 820.57

Moorefield, 2.0 miles south of, 15 feet north of public road crossing, on southwest corner of cattle-guard, in wooden support; copper nail, painted "822.6" ------------------ 821.71

Moorefield, 3.0 miles south of, 500 feet east of Baltimore and Ohio Railroad, on north side of A. V. Wilson's residence, on top of cement horse block; bronze tablet stamped "W. Va. 842" -------------------------------------- 840.658

From near southwest corner north along highways to Moorefield.

Moorefield, 5.8 miles southwest of, on South Fork road, at second-class T road east, in root of 14-inch pine tree; copper nail, painted "901.6" ------------------------------ 900.65

Moorefield, 5.0 miles southwest of, on South Fork road, in front of H. C. Harper's residence, on west edge of road, in wooden step to granary; copper nail, painted "917.6"---- 916.64

Moorefield, 4.0 miles southwest of, on South Fork road, 10 feet curb; chiseled square, painted "912.3" ----------------- 911.33
west of barn, on northwest edge of road, in cement well

Moorefield, 3.3 miles south of, 50 feet west of road, 60 feet north of T road west, northeast corner of residence, in cement foundation; bronze tablet stamped "W. Va. 914"-- 913.065

Moorefield, 2.4 miles south of, on South Fork road, at second-class T road west, 15 feet south of gate, in telephone-pole; iron spike, painted "888.5" ---------------------------- 887.54

Moorefield, 1.1 miles south of, on South Fork road, 60 feet northeast of Kuhn & Company's store, on north edge of road, in root of 14-inch oak tree; copper nail, painted "896.7" -- 895.68

Moorefield, 50 feet southwest of railroad station, 10 feet west of track, 10 feet south of highway, at northeast corner of Piedmont Grocery store, in cement step; bronze tablet stamped "W. Va. 821" -------------------------------- 820.195

Third order leveling by F. L. Shalibo in 1920:

From Keyser Quadrangle southwest along highways to point 4.5 miles north of Moorefield.

Purgitsville, 80 feet south of T road west, 70 feet south of stream crossing, on east edge of road, in root of large tree; copper nail, marked "933.6" ---------------------- 933.00

Purgitsville, 0.6 mile southeast of, in northeast corner of T road east, 30 feet east of road, in root of oak tree; copper nail, marked "981.5" ---------------------------------- 980.91

Purgitsville, 1.5 miles southeast of, 300 feet south of divide, in southeast corner of foundation of small building, on west edge of road; bronze tablet stamped "W. Va. 1920 1,091" --1,090.191

Purgitsville, 2.4 miles southeast of, 50 feet south of W. R. High's store, on southeast corner of wooden bridge over small stream, in wooden support, copper nail, marked "993.2" -- 992.54

Purgitsville, 3.3 miles southeast of, 4.7 miles north of **Old Fields**, 20 feet east of road, on southwest corner of cement walk; chiseled square, marked "970.6" ---------------- 969.99

Purgitsville, 3.8 miles southeast of, 4.2 miles north of **Old Fields store**, in southwest corner of T road west, in north end of guard-rail of cement culvert; bronze tablet stamped "W. Va. 1920 967" --------------------------------- 966.368

Purgitsville, 4.6 miles southeast of, 3.4 miles north of **Old Fields store**, in southwest corner of T road west, on southwest corner of wooden bridge, in support; copper nail, marked "931.8" --------------------------------------- 931.21

Purgitsville, 5.5 miles southeast of, 2.5 miles north of **Old Fields store**, 100 feet north of T road west, 40 feet west of road, in root of large oak tree; copper nail marked "899.3" -- 898.68

Purgitsville, 6.0 miles southeast of, 2.0 miles north of **Old Fields store**, 80 feet north of wooden bridge over large stream, 30 feet north of T road southeast, 10 feet east of road, in large boulder; bronze tablet stamped "W. Va. 1920 879" ---------- 877.924

Old Fields, 1 mile north of, near south end of gate to field, about 10 feet east of road, in root of 16-inch tree; copper nail, painted "774.8" ---------- 774.16

Old Fields, about 40 feet south of post-office, 20 feet west of road, at east end of cement walk to A. Leatherman's residence; chiseled square, marked "808.4" ---------- 807.73

Moorefield, 4.5 miles north of, 200 feet north of McNeill's residence, in top of south end of west rail of cement bridge; bronze tablet stamped "W. Va. 1919 791" ---------- 790.069

From point 3.1 miles north of Moorefield northeast along Baltimore and Ohio Railroad (Petersburg Branch) to Keyser Quadrangle.

Moorefield, about 3.1 miles north of, at west end of bridge over South Branch of Potomac River, on north abutment; chiseled square, painted "798.8" ---------- 797.96

Moorefield, about 3.1 miles north of, at west end of bridge over South Branch of Potomac River, on west end of guardwall, on north side of road; bronze tablet stamped "W. Va. 1920 798" ---------- 798.029

Cunningham Station, in northeast corner of road crossing, in base of danger-sign; iron spike, painted "787.0" ---------- 787.15

Cunningham Station, 1.0 mile northeast of, 0.4 mile southwest of **Mapleton** flag-stop, 50 feet east of track, in root on south side of large tree; copper nail, painted "773.3" ---------- 773.46

Cunningham Station, 1.4 miles northeast of, on Baltimore and Ohio Railroad, at **Mapleton** flag-stop, at north end of siding, on east end of south tie to switch-lever; copper nail, painted "771.5" ---------- 771.71

Cunningham Station, 2.2 miles northeast of, at Poland's farm, at north end of barn, on north side of cement foundation of silo; bronze tablet stamped "W. Va. 1920 778" ---------- 777.778

McNeill Station, 300 feet north of, on east edge of track, in east end of south tie to switch-lever: copper nail, painted "773.9" ---------- 774.08

McNeill Station, 1.0 mile northeast of, on top of northeast corner of north abutment of iron bridge over South Branch of Potomac River, at **Sycamore** flag-stop; bronze tablet stamped "769" ---------- 768.827

Trough Club, 2.9 miles southwest of, at Gribble's lumber camp, at north end of siding, on west end of tie to switch-lever; copper nail, painted "759.5" ---------- 759.61

Trough Club, 1.9 miles southwest of, 1.0 mile northeast of Gribble's lumber camp, on west edge of track, in ledge of rock; chiseled square, painted "747.7" ---------- 747.82

Trough Club, 0.8 mile southwest of, 2.1 miles northeast of Gribble's lumber camp, in west edge of track, in ledge of rock; chiseled square, painted "746.9" ---------------- 747.00

Trough Club, on east edge of track, opposite club-house, in south end of cement wall; bronze tablet stamped "W. Va. 1920 742" -- 741.998

Wickham Station, on southwest corner of wooden bridge over small stream, in wooden support; copper nail, painted "741.8" -- 741.88

Sector Station, 600 feet east of, at southwest corner of county bridge over South Branch of Potomac River, in stone abutment; bronze tablet stamped "W. Va. 1920 726" ---------- 725.711

Sector Station, 1.0 mile northeast of, at southwest corner of bridge No. 560, in wooden support; copper nail, painted "723.2" -- 723.27

From Wardensville Quadrangle southwest along highways in east part of Quadrangle to Orkney Springs Quadrangle.

Inkerman, 7.1 miles north of, 12.6 miles southeast of **Romney**, 40 feet east of road, in foundation of house; bronze tablet stamped "W. Va. 1920 2,043" ------------------------------2,042.506

Inkerman, 6.3 miles north of, 100 feet north of small stream crossing, 30 feet east of road, in root of old stump; copper nail, marked "1,828.3" --------------------------------1,827.60

Inkerman, 4.9 miles north of, on second-class road, 100 feet north of **Horn Camp School**, on south edge of creek, on west edge of road, in root of 16-inch tree; copper nail, marked "1,643.0" --1,642.27

Inkerman, 4.0 miles north of, on Horn Camp Run, in southeast corner of east wall of B. Saville's residence; bronze tablet stamped "W. Va. 1920 1,544" ---------------------------1,542.874

Inkerman, 3.0 miles north of, on Horn Camp Run, 1.1 miles north of corners, on east edge of road, in root of old stump; copper nail, marked "1,454.5" ------------------1,453.83

Inkerman, 0.9 mile east of, on North River pike, about 400 feet east of stream crossing, on north edge of road, in front of residence, in large boulder; bronze tablet stamped "W. Va. 1920 1,419" ---1,418.175

Inkerman, 90 feet west of William Jackson Bean's store, at three corners, on south edge of road, in root of large tree; copper nail, marked "1,476.6" ----------------------------1,475.86

Inkerman, 1.0 mile southwest of, at top of steep hill, 130 feet south of old house, 20 feet east of road, in fence line, in root of old stump; copper nail, marked "1,775.4" --------1,774.65

Inkerman, 1.7 miles southwest of, on North River pike, in east corner of foundation of J. A. Bean's farm house; bronze tablet stamped "W. Va. 1920 1,906" -------------1,905.322

Inkerman, 2.7 miles southwest of, on North River pike, on south edge of road, at T road south, in root of large tree; copper nail, painted "1,946.8" ----------------------------1,946.05

Inkerman, 3.9 miles southwest of, on North River pike, on northeast corner of cement steps to **Asbury Church**, 300 feet northeast of road forks; chiseled square, marked "2,079.6" ---------- 2,078.90

Inkerman, 4.3 miles southwest of, on North River pike, in east face at northeast corner of cement porch of C. L. Burch's store; bronze tablet stamped "W. Va. 1920 2,162" ---------- 2,160.854

Inkerman, 5.5 miles southwest of, at junction of North River pike and Wardensville pike, 9.5 miles east of **Moorefield**, 0.7 mile west of **Fabius**, on south edge of road, in root of large tree; copper nail, marked "2,192.2" ---------- 2,191.46

Fabius, 0.6 mile south of, in southwest corner of T road north, near small stream crossing, in root of 10-inch tree; copper nail, marked "2,025.1" ---------- 2,024.22

Fabius, 1.2 miles south of, near top of hill, on Wardensville pike, in stone chimney, on east side of R. Brill's residence; bronze tablet stamped "W. Va. 1920 2,271" ---------- 2,270.465

Fabius, 2.3 miles south of, on Wardensville pike, at top of mountain, in front of Simon Bean's residence, on north edge of road, in root of old stump; copper nail, marked "2,302.5" ---------- 2,301.67

Fabius, 3.6 miles south of, on Wardensville pike, opposite T road northeast, on west edge of road, in root of large tree; copper nail, marked "1,840.1" ---------- 1,839.27

Fabius, 4.5 miles south of, at junction of Wardensville pike, T road south, in corner-stone at northeast corner of Charles Whetzel's farm house; bronze tablet stamped "W. Va. 1920 1,775" ---------- 1,774.188

Fabius, 5.8 miles south of, at T road north, opposite **Pine Grove Church**, 50 feet east of small bridge, on west edge of road, in old stump; copper nail, marked "1,652.6" ---------- 1,651.77

Fabius, 6.7 miles south of, on Camp Branch road, 150 feet east of J. T. Comb's residence, in sill at northeast corner of blacksmith shop; copper nail, marked "1,671.9" ---------- 1,671.11

Fabius, 8.1 miles south of, on Camp Branch road, 400 feet west of road, in east face of foundation at northeast corner of Robert Wilkin's residence; bronze tablet stamped "W. Va. 1920 1,904" ---------- 1,903.240

Holly Hill Church, 5.4 miles north of, on Camp Branch road, at top of mountain on west edge of road, in large rock; chiseled square, painted "2,204.6" ---------- 2,203.71

Holly Hill Church, 4.5 miles north of, on Camp Branch road, near small stream crossing, on west edge of road, in root of 18-inch oak tree; copper nail, painted "2,032.9" ---------- 2,032.05

Holly Hill Church, 3.4 miles north of, on Camp Branch road, in front of farm house, 130 feet west of road, in large boulder; bronze tablet stamped "W. Va. 1920 1,858" ---------- 1,857.494

From Orkney Springs Quadrangle northwest along highways to point 5.0 miles southwest of Moorefield.

Harpers Chapel, 1.1 miles east of, on Branch Mountain road, 20 feet north of road, in root of 24-inch oak tree; copper nail, painted "1,165.0" ---------------------------------1,164.07

Moorefield, 5.0 miles southwest of, on South Fork road, in front of H. C. Harper's residence, on west edge of road, in wooden step of granary; copper nail, painted "917.6" ---- 916.61

Third order leveling by E. E. Harris in 1921:

From Wardensville Quadrangle west along highways to point 4.5 miles south of Needmore Post-Office.

Baker Run, 0.73 mile west of, on west edge of road, just north of angle in road, in center of west wall of small concrete culvert over drain; chiseled square, culvert marked "U. S. 1,354.2 B. M." --1,354.31

Baker Run, 1.64 miles west of, on east edge of road, 0.20 mile west of **Baker Run Church**, in sharp angle in road, near forks of lane to church, in south root of 6-inch maple tree; copper nail and washer, tree marked "U. S. 1,415.1 B. M." ------------------------- ----------------------1,415.23

Baker Run, 2.39 miles west by 0.26 mile northeast of **Needmore Post-Office**, on south edge of road, at forks of road, on top of ledge of rock; chiseled square, ledged marked "U. S. 1,456.3 B. M." -----------------------------------1,456.42

Needmore, in front of post-office; center of road -----------1,475.4

Needmore Post-Office, 0.83 mile west of, on north edge of road, in line with T road south, in south root of 15-inch oak tree; copper nail and washer, tree marked "U. S. 1,569 B. M." --1,569.07

Fabius, 4.5 miles south by 1.68 miles west of **Needmore Post-Office**, at junction of Wardensville pike and Y road south, in corner-stone, at northeast corner of Charles Whetzel's house (now abandoned); bronze tablet stamped "W. Va. 1920 1,775" --1,774.188

Reference bench mark, in north root of 12-inch cherry tree, 48 feet N. 65° E. of tablet; copper nail and washer--------1,767.52

WARDENSVILLE QUADRANGLE: HAMPSHIRE AND HARDY COUNTIES.

(Latitude 39°-39° 15′; Longitude 78° 30′-78° 45′.)

Third order leveling by F. L. Shalibo in 1920:

From Hanging Rock Quadrangle near southwest corner, south along highways and west into Moorefield Quadrangle.

Inkerman, 9.9 miles north of, 9.8 miles southeast of **Romney**, near top of long hill, about 200 feet east of road, in foundation of barn; bronze tablet stamped "1,956" -----------1,955.355

Inkerman, 8.4 miles north of, 11.3 miles southeast of **Romney,** at road forks of T road east, 15 feet west of road, in fence corner, in large boulder; chiseled square, marked "1,771.3" ---------- 1,770.63

Inkerman, 1.9 miles east of, on North River pike, 340 feet east of stream crossing, 30 feet west of road forks, on north edge of road, in root of 14-inch tree; copper nail, marked "1,376.4" ---------- 1,375.67

Third order leveling by E. E. Harris in 1921:

From Sedan south along highway to Rio, thence west to Inkerman.

Sedan, 0.81 mile north of, on west side of road, on south side of angle in fence line, just north of house, in east root of 18-inch apple tree; copper nail and washer, "T. B. M. 907.6" marked on fence-post ---------- 907.63

Sedan, about 200 feet north of post-office, in northwest corner of crossroads, in pasture, set in top of concrete post; bronze tablet stamped "928 H 26 1921 W. Va.", "P. B. M. 928" marked on telephone-pole ---------- 928.058

Reference bench mark, on top of outcrop of rock, at base of corner fence-post, 50.6 feet south of tablet; chiseled square ---------- 929.72

Sedan, 1.12 miles south by 0.46 mile northeast of **Del Ray,** in center of large grass triangle formed by roads in three directions, in west root of 30-inch sycamore tree; copper nail and washer, tree blazed and marked "T. B. M. 935.7" 935.77

Del Ray, on east side of road, opposite post-office, in yard of J. W. McDonald, in west root of 15-inch ash tree; copper nail and washer, telephone-pole marked "T. B. M. 953.2"-- 953.33

Del Ray, 0.47 mile south of, on east edge of road, 70 feet south of road forks, in west root of 24-inch elm tree; copper nail and washer, "T. B. M. 946.1" marked on tree ---------- 946.21

Del Ray, 0.94 mile southwest of, on north side of road, in right-angle turn in road, 50 feet west of barn, in line with lane crossing North River, in top of concrete post; bronze tablet stamped "H 27 1921 W. Va. Elev. 954", "P. B. M. 953.7" marked on fence-post ---------- 953.853

Reference bench mark, 41.4 feet south of tablet, in east root of 30-inch oak tree; copper nail and washer---------- 950.33

Del Ray, 2.22 miles southwest of, on south edge of road, in line with forks of road north, on west bank of Lick Run. in north root of 30-inch elm tree; copper nail and washer, "T. B. M. 978.7" marked on blazed tree ---------- 978.84

Del Ray, 2.87 miles southwest of, on south edge of road, 160 feet west of lane to house, on north bank of river, in north root of 48-inch oak tree; copper nail and washer, "T. B. M. 988.3" marked on fence ---------- 988.38

Del Ray, 3.62 miles southwest by 3.55 miles northeast of **Rio,** on west side of road, in southeast corner of lower stone step, at entrance to home of J. W. Kaufman; chiseled square, "T. B. M. 1,027" marked on telephone-pole--------1,027.12

Rio, 2.74 miles northeast of, in northwest corner of road forks, in east face near south corner of stone foundation to school; (porch built over this B. M.) bronze tablet stamped "H 28 1921 W. Va. Elev. 1027", "P. B. M. 1,026.6" marked on telephone-pole --------------------------------1,026.750

Reference bench mark, 70.9 feet N. 75° E. of tablet, in root of tree; copper nail --1,025.30

Rio, 1.49 miles northeast of, on north edge of road, east side of hollow, in east root of 15-inch walnut tree; copper nail and washer, tree blazed and marked "T. B. M. 1,086" ----------1,086 15

Rio, 0.66 mile northeast of, on east edge of road, in west root of 10-inch locust tree; copper nail and washer, tree marked "T. B. M. 1,122.5" ------- ----------------------1,122.73

Rio, 400 feet south of post-office, in southwest corner of top stone step at entrance to **Rio Baptist Church;** bronze tablet stamped "H 29 1921 W. Va. Elev. 1135", "P. B. M. 1,135.1" marked on telephone-pole -----------------------1,135.265

Reference bench mark, 68.1 feet N. 20° E. of tablet, on top of rock outcrop; chiseled square ----------------------------1,134.04

Rio, 1.09 miles west of, on south edge of road, on east edge of small run, just west of gate, on top of boulder; chiseled square, "T. B. M. 1,188.1" marked on gate-post ----------1,188.22

Rio, 1.96 miles west of, in northeast corner of lane north to farm house, on top of rock outcrop; chiseled square, "T. B. M. 1,273.9" marked on rock ----------------------------1,274.09

Rio, 3.08 miles west by 1.09 miles east of **Rock Oak,** on south edge of road, 50 feet west of right-angle turn in road, on top of ledge of rock; chiseled square, "T. B. M. 1,332" marked on fence-post -----------------------------------1,332.18

Rock Oak, 100 feet east of post-office, on south side of road, just west of road forks, 15 feet west of stream, in northeast corner of garden, in top of concrete post; bronze tablet stamped "H 30 1921 W. Va Elev. 1350", "P. B. M. 1,350.1" marked on post --------------------------------1,350.355

Reference bench mark, 51.2 feet N. 50° E. of tablet, in north root of 18-inch maple tree; copper nail and washer------1,350.98

Inkerman, 1.9 miles east by 0.5 mile west of **Rock Oak,** on North River pike, 340 feet east of stream crossing, 30 feet west of road forks, on north edge of road, in root of 14-inch tree; copper nail and washer -----------------------1,375.670

Third order leveling by E. E. Harris in 1921:

From Middletown Quadrangle along highways southwest to Wardensville, thence west into Moorefield Quadrangle.

Yellow Springs, 1.43 miles northeast of, on west edge of road and just south of forks of road east to Gore, in corner of pasture, in top of concrete post; bronze tablet stamped "862 H 47 1921 W. Va.", fence marked "U. S. 862.1 B. M." ---------- 862.138

Reference bench mark, on top of boulder, 39.6 feet N. 25° E. of above tablet; chiseled square ---------- 860.50

Yellow Springs, 0.80 mile northeast of, in forks of Y road crossing river, on top of large boulder; chiseled square, boulder marked "U. S. 874.7 B. M." ---------- 874.68

Yellow Springs, 150 feet west of post-office, on north edge of road, on top of flat outcrop of rock between two sheds; chiseled square, telephone-pole marked "U. S. 900.7 B. M." ---------- 900.68

Yellow Springs, 0.79 mile southwest of, on west edge of road, 100 feet south of dwelling, in east root of 15-inch sycamore tree; copper nail and washer, fence marked "U. S. 924.2 B. M." ---------- 924.22

Yellow Springs, 1.39 miles southwest of, on west edge of road, just north of dwelling, on top of large boulder; chiseled square, boulder marked "U. S. 911.4 B. M." ---------- 911.46

Yellow Springs, 1.80 miles southwest of, by 1.52 miles northeast of **Intermont Post-Office,** on west edge of road, near south end of fence to cottage of A. Reymann, in center of top of large flat boulder; bronze tablet stamped "901 H 48 1921 W. Va.", fence marked "U. S. 901 B. M." ---------- 901.074

Reference bench mark, on top of large boulder, just west of large cedar tree, 37 feet S. 12° W. of tablet; chiseled square ---------- 895.95

Intermont Post-Office, on east side of road, in center of small triangle formed by forks of T road east to Capon Springs, on top of pointed boulder; chiseled square, boulder marked "U. S. 887.8 B. M." ---------- 887.86

Intermont Post-Office, opposite, on west edge of road, on top of large outcrop of rock; chiseled square, rock marked "U. S. 940.2 B. M." ---------- 940.20

Intermont Post-Office, 0.85 mile southwest of, on west edge of road, 10 feet south of lane east through gate, on top of large boulder; chiseled square, boulder marked "U. S. 1034.4 B. M." ----------1,034.39

Intermont Post-Office, 1.43 miles southwest of, on east edge of road, south edge of stream, on top of large flat outcrop of rock; chiseled square, rock marked "U. S. 940.5 B. M."-- 940.60

Intermont Post-Office, 2.05 miles southwest, by 3.91 miles northeast of **Wardensville Post-Office**, on east edge of road, inside fence line, in front of dwelling of Wm. Baker, in top of concrete post; bronze tablet stamped "944 H 49 1921 W. Va.", fence marked "U. S. 944.4 B. M." ---------- 944.457

Reference bench mark, in south root of 30-inch maple tree, 37 feet N. 45° W. of tablet; copper nail and washer-------- 947.91

Wardensville Post-Office, 3.13 miles northeast of, on east edge of road, 25 feet north of **Crest Hill Church**, in west root of 20-inch oak tree; copper nail and washer, fence marked "U. S. 1,043.8 B. M." ----------------------------------1,043.87

Wardensville Post-Office, 2.26 miles northeast of, in west end of south concrete abutment; chiseled square, abutment marked "U. S. 943.1 B. M."; "U. S. B. M." is cut on concrete -- 943.19

Wardensville Post-Office, 1.53 miles northeast of, on south edge of road, 100 feet east of road forks, in north root of 25-inch sycamore tree; copper nail and washer, tree marked "U. S. 955.9 B. M." ----------------------------- 955.94

Wardensville Post-Office, 0.84 mile northeast of, on east edge of road and south edge of road east, in west root of 14-inch elm tree; copper nail and washer, fence marked "U. S. 994 B. M." --- 994.02

Wardensville, in front of station; top of nearest rail, "1,001.5" marked on tie ---1,001.6

Wardensville, center of road, in front of post-office ---------1,001.6

Wardensville, 0.20 mile west of post-office, in large grass triangle formed by road and angle in fence line, in front of Hotel Warden, set in top of concrete post; bronze tablet stamped "1011 H 50 1921 W. Va." ----------------------1,010.942

Reference bench mark, in west root of large maple tree, 39.2 feet east of tablet; copper nail and washer ------------1,011.89

Wardensville, 0.53 mile west of post-office, east end of north parapet wall to concrete bridge over Trout Run; chiseled square -- 990.37

Wardensville Post-Office, 1.18 miles west of, on north edge of road opposite house to south, on top of pointed boulder; chiseled square, boulder marked "U. S. 1,036.7 B. M."----1,036.82

Wardensville Post-Office, 1.54 miles west of, in southwest corner of road forks, on top of boulder; chiseled square, marked "1,097" ---1,096.88

Wardensville Post-Office, 2.15 miles west of, on north edge of road, east edge of trail north, on top of large boulder; chiseled square, boulder marked "U. S 1,323 B. M."------1,323.12

Wardensville Post-Office, 2.73 miles west of, on south edge of road, in gap, on east edge of trail south to Ruby Path, in top of outcrop of rock; bronze tablet stamped "1516 H 1921 W. Va.", boulder marked "U. S. 1,516.3 B. M." ------1,516.311

Reference bench mark, on top of rock outcrop, 33.4 feet N. 15° W. of tablet; chiseled square ---------------------------1,517.74

Wardensville Post-Office, 3.85 miles west of, on east edge of road, on top of large round boulder; chiseled square, boulder marked "U. S. 1,159.2 B. M." ----------------------1,159.29

Wardensville Post-Office, 4.12 miles west of, on top of northwest wing-wall of highway bridge over Lost River; chiseled square, boulder marked "U. S. 1,156.6 B. M."----1,156.66

Wardensville Post-Office, 4.68 miles west by 3.42 miles northeast of **McCauley Post-Office,** in northeast corner of forks of road, 200 feet east of Sour Kraut Run, ou top of outcrop of rock; chiseled square, rock marked "U. S. 1,161 B. M." --1,161.12

McCauley Post-Office, 2.72 miles northeast of, on north edge of road, just west of drain, on top of rock ledge; chiseled square, ledge marked "U. S. 1,207.7 B. M." --------------1,207.79

McCauley Post-Office, 2.16 miles northeast of, known as **Ash Bottom,** on east edge of road, at south end of drive out in road, on inside of angle in fence line, in top of concrete post; bronze tablet stamped "1184 H 52 1921 W. Va.", fence marked "U. S. 1,184 B. M." -----------------1,184.142

Reference bench mark, in west root of 15-inch shell-bark tree, 75.4 feet N. 70° E. of tablet; copper nail and washer-----1,182.26

McCauley Post-Office, 1.19 miles northeast of, in forks of Y road, 150 feet west of Pine Ridge School, in south root of 12-inch oak tree; copper nail and washer, tree marked "U. S. 1,431.2 B. M." ---------------------------------------1,431.31

McCauley Post-Office, 0.60 mile northeast of, on west edge of road, north edge of run, on top of boulder; chiseled square, marked "1,296" ---------------------------------1,296.31

McCauley Post-Office, 30 feet north of, on south edge of road, just west of road forks, on top of large flat boulder; chiseled square, boulder marked "U. S. 1,264.1 B. M."----1,264.18

McCauley Post-Office, 1.03 miles west by 2.24 miles northeast of **Baker Run,** 40 feet north of road center, on east side of **Hetzell Hollow,** in top of concrete post; bronze tablet stamped "1278 H 53 1921 W. Va.", tree marked "U. S. 1,277.5 B. M." --1,277.606

Reference bench mark, in west root of 20-inch oak tree, 27.8 feet N. 30° W. of tablet; copper nail and washer--------1,275.246

Baker Run, 1.73 miles northeast of, on west edge of road, 60 feet north of road forks, in south root of 12-inch sycamore tree; copper nail and washer, tree marked "U. S. 1,276.4 B. M." --1,276.52

Baker Run, 0.96 mile northeast of, on east edge of road, 70 feet southeast of small bridge over run, inside fence line, in south root of 18-inch waltnut tree; copper nail and washer, tree marked "U. S. 1,301.6 B. M." -------------1,301.78

Baker Run, about 300 feet south of post-office, 60 feet west of road center, just north of Baker Run and opposite north end of concrete bridge over Baker Run, in top of concrete post; bronze tablet stamped "H 54 1921 W. Va. Elev. 1306", bridge marked "U. S. 1,306 B. M." ---------------1,306.090

Witness bench mark, in east root of 6-inch locust tree, 38.4 feet N. 30° W. of tablet; copper nail and washer --------1,308.33

Baker Run, in south end of east parapet wall to concrete bridge over Baker Run; chiseled square, marked "1,312.6" ---1,312.77

From Wardensville south along highways into Edinburg Quadrangle. Spur line leveled twice.

Wardensville, 0.20 mile west of post-office, in front of Hotel Warden, in center of large grass triangle formed by road and angle in fence line, set in top of concrete post; bronze tablet stamped "H 50 1921 W. Va. Elev. 1011" -----------1,010.942

Reference bench mark, in west root of 36-inch maple tree, 39.2 feet east of tablet; copper nail and washer --------------1,011.89

Wardensville Post-Office, 1.12 miles south of, on west edge of road, inside fence line and 30 feet north of lane east to dwelling, in north root of 10-inch locust tree; copper nail and washer, tree marked "U. S. 1,138.5 B. M." ----------1,138.52

Wardensville Post-Office, 1.88 miles south of, on inside of right-angle turn in road to south, in north root of 30-inch oak tree; copper nail and washer, tree marked "U. S. 1,137.4 B. M." ---1,137.50

Wardensville Post-Office, 2.36 miles south of, in forks of Y road, on top of flat boulder; chiseled square, fence marked "U. S. 1,114.8 B. M." ------------------------------------1,114.84

Wardensville Post-Office, 2.84 miles south of, 60 feet west of road center, 30 feet south of **Heishman School**, in top of large boulder; bronze tablet stamped "H 55 1921 W. Va. Elev. 1125", fence marked "U. S. 1,125 B. M." -----------1,125.063

Reference bench mark, on top of boulder, 40.9 feet south of tablet; chiseled square ---------------------------------1,123.28

Wardensville Post-Office, 3.45 miles south of, on west edge of road, at forks of road, in east root of 20-inch spruce tree; copper nail and washer, tree marked "U. S. 1,161.9 B. M." --1,161.93

Wardensville, 4.22 miles south of, on east edge of road, 50 feet north of dim trail, in west root of 15-inch oak tree; copper nail and washer, tree marked "U. S. 1,344.2 B. M."--------1,344.25

Wardensville Post-Office, 5.02 miles south of, 50 feet east of road center, in gap, on north edge of trail, east along ridge, in root of 10-inch oak tree; copper nail and washer, tree marked "U. S. 1,614.6 B. M." ----------------------1,614.53

Wardensville Post-Office, 5.61 miles south by 4.37 miles north of **Perry Post-Office**, in forks of Y road, on top of large boulder; chiseled square, boulder marked "U. S. 1,380.3 B. M." ---1,380.25

Perry Post-Office, 3.35 miles north of, 50 feet east of road center, 150 feet south of Trout Run, in top of concrete post; bronze tablet stamped "1464 H 56 1921 W. Va.", rock marked 1,464.1 B. M." ----------------------------------1,464.113

Reference bench mark, on top of flat boulder, 40.7 feet S. 50° E. of tablet; chiseled square ----------------------------1,464.98

PETERSBURG QUADRANGLE: GRANT, HARDY, AND PENDLETON COUNTIES.

(Latitude 38° 45′-39°; Longitude 79°-79° 15′.)

Third order leveling by Walter McCrea in 1919:

From near Hopeville, Onego Quadrangle, northeast along highways near north border of Quadrangle into Greenland Gap Quadrangle northwest of Petersburg.

Hopeville, 1.3 miles east of, 500 feet east of road leading to Joseph Turner's farm, 5 feet north of road, in large rock; bronze tablet stamped "1,244 W. Va." -------------------1,243.348

Hopeville, 2.5 miles east of, 1,500 feet east of two small shanties, 15 feet north of road, in large flat rock; chiseled cross mark, "T. B. M. 1,081" marked on stone ------------1,081.12

Hopeville, 3.6 miles east of, 150 feet east of wooden bridge, north side of road, on large rock; chiseled cross mark, stone marked "T. B. M. 1,055" ------------------------1,054.81

Third order leveling by F. L. Shalibo in 1919:

From near northeast corner of Quadrangle west along Baltimore and Ohio Railroad to Petersburg.

Moorefield, 6.3 miles south of, 500 feet east of **Spring Brook** flag-station, on Baltimore and Ohio Railroad, in concrete foundation of silo; bronze tablet stamped "W. Va. 859" -- 858.195

Moorefield, 7.2 miles south of, on Baltimore and Ohio Railroad, 6.0 miles east of **Petersburg**, at small stream crossing, on east edge of track, in top of cement culvert; chiseled square, painted "876.9" ---------------------------------- 875.59

Petersburg, 5.0 miles east of, on Baltimore and Ohio Railroad, at **Durgon Station**, in north end of west bent of bridge 583; iron pin, painted "876.9" ------------------------- 875.91

Petersburg, 4.5 miles east of, 300 feet south of track, in base of cement silo, at Seymour Fisher's residence; bronze tablet stamped "W. Va. 893" --------------------------------- 891.992

Petersburg, 2.0 miles east of, on Baltimore and Ohio Railroad, at west end of gap, at sharp curve on south edge of track, in ledge of rock; chiseled square, painted "914.8" -------- 913.80

Petersburg, 1.5 miles east of, in northeast corner of wooden bridge over Mill Creek, in wooden support; copper nail, painted "913.5" -- 912.44

Petersburg, 400 feet west of railroad station, in center of north timber of base of water-tank; copper nail, painted "936.0" -- 935.20

Petersburg, at north end of Main Street, in base of water-tank, on west side; bolt, painted "1,037.0" ------------------1,036.21

Petersburg, 50 feet west of court-house, 50 feet south of road, in cement block; bronze tablet stamped "W. Va. 938"---- 936.957

Primary leveling by Walter McCrea in 1919:

From Petersburg southwest along highways to west border of Quadrangle.*

Petersburg, at railroad crossing, at station; top of south rail 932.3

Petersburg, 1.1 miles southwest of, northwest side of road, in root of sycamore tree; copper nail and washer, tree marked "T. B. M. 1,000" --------- --------------------- 999.56

Petersburg, 2 miles southwest of, 50 feet north of Ben Jenkins's dwelling, on west side of road, on small ledge of rocks; chiseled square, "T. B. M. 1,101", marked on post--1,100.47

Petersburg, 3.1 miles southwest of, north end of east side of concrete bridge over small stream; bronze tablet stamped "1,086 W. Va." --1,085.470

Petersburg, 3.9 miles southwest of, north side of road, in large iron culvert; chiseled cross, marked "T. B. M. 1,018"----1,017.47

Petersburg, 4.7 miles southwest of, at gate leading to field of J. Ed. Bergdoll, east side of road, in root of cedar tree; copper nail and washer, marked "T. B. M. 1,040"--------1,038.90

Petersburg, 5.7 miles southwest of, south abutment of east side of concrete bridge over North Mill Creek; bronze tablet stamped "1,051 W. Va." ---------------------------------1,050.492

Pansy Post-Office, 0.5 mile south of, east side of road, opposite gate to field, in root of large oak tree; copper nail and washer, tree marked "T. B. M. 1,093" ------------------1,091.67

Pansy Post-Office, 1.4 miles south of, 290 feet west of **Landes Post-Office,** in south end of wooden bridge; copper nail and washer, marked "T. B. M. 1,129" -------------------1,128.00

Landes Post-Offiice, 1.6 miles southwest of, 50 feet southeast of O. B. Kimble's dwelling, east side of road, in flat rock over culvert; bronze tablet stamped "1,155 W. Va." ----------1,154.287

Landes Post-Office, 2.8 miles southwest of, east side of road, opposite gate to field, in root of pine tree; copper nail and washer, marked "T. B. M. 1,210" -------------------1,208.58

Landes Post-Office, 3.6 miles southwest of, 120 feet south of Lige Judy's dwelling, northwest side of road, on large rock; chiseled square, marked "T. B. M. 1,226"-----------1,225.17

*Line enters Onego Quadrangle.

Landes Post-Office, 4.6 miles south of, at **Alt Schoolhouse**, 80 feet north of road, in southeast end of stone foundation; bronze tablet stamped "1,246 W. Va." ------------------1,245.430

Third order leveling by F. L. Shalibo in 1919:

From Petersburg along highways south to Wine Spring School, thence northeast to east border of Quadrangle.

Petersburg, 1.0 mile south of, on Turkey Knob road, in southwest corner of bridge over small run, in stone abutment; chiseled square, painted "974.8" ------------------------ 973.95

Petersburg, 1.7 miles south of, on Turkey Knob road, at three corners, in northwest corner of forks, in root of small tree; copper nail, painted "1,164.4" --------------------1,163.64

Petersburg, 2.29 miles south of, at country store, 150 feet west of road, under south sill at stable door of Isaac Shobe's barn; bronze tablet stamped "W. Va. 944" -------------- 943.393

Petersburg, 3.6 miles south of, on west edge of road, opposite T road east, in root of large tree; copper nail, painted "969.1" -- 968.32

Petersburg, 4.5 miles south of, 0.20 mile north of **Dorcas School**, in northeast corner of bridge over small stream, in wooden support; copper nail painted "1,025.7"--------1,024.94

Petersburg, 4.9 miles south of, 100 feet north of **Dorcas Post-Office**, on west side of road, in south wall at southwest corner of Lutheran parsonage; bronze tablet stamped "W. Va. 1,067" ---1,065.850

Dorcas, 1.0 mile south of, 80 feet north of T road east, 100 feet south of D. C. Mongold's residence, on east edge of road, in root of large tree; copper nail, painted "1,028.4"------1,027.64

Dorcas, 2.1 miles south of, 100 feet south of **Hedrick Church**, on east edge of road, in root of 10-inch pine tree; copper nail, painted "1,069.6" ----------------------------------1,068.77

Rough Run School, 0.7 mile north of, 50 feet south of Rough Run, opposite T road east, in root of large tree; copper nail, painted "1,111.1" ------------------------------------1,110.28

Rough Run School, at three corners, at southwest corner, in south foundation of Rough Run Schoolhouse; bronze tablet stamped "W. Va. 1,155" ------------------------------1,154.655

Rough Run School, 0.9 mile southeast of, on second-class road, 500 feet south of old farm buildings, at top of small hill, on west edge of road, in large boulder; chiseled square, painted "1,366.3" ------------------------------1,365.54

Rough Run School, 1.7 miles southeast of, on second-class road at T road north, at northwest corner of bridge, in large boulder; chiseled square, painted "1,622.6" -------------1,621.82

Rough Run School, 2.5 miles southeast of, at three corners, in center of forks, 8 feet north of rail fence, in large boulder; bronze tablet stamped "W. Va. 1,992" -------------------1,991.551

Rough Run School, 3.8 miles southeast of, at top of first mountain, on southwest edge of road, in root of locust tree; copper nail, painted "2,385.1" ---------- 2,384.33

Rough Run School, 4.7 miles southeast of, at bottom of ravine, 200 feet north of house, at sharp bend in road, in root of large oak tree; copper nail, painted "2,015.4" ---------- 2,014.60

Rough Run School, 5.5 miles south of, opposite second-class road to Isaac Simmons's residence, 8 feet west of road, in large boulder; bronze tablet stamped "W. Va. 2,291" -- 2,290.155

Wine Spring School, 2.1 miles northwest of, 0.65 mile south of Isaac Simmons's residence, on horseback trail, near head of ravine, 200 feet north of gate, in rock; chiseled square, painted "2,366.1" ---------- 2,365.28

Wine Spring School, 1.1 miles west of, on horseback trail, at northwest corner of old cabin, in small rock; chiseled square, painted "1,790.1" ---------- 1,789.26

Wine Spring School, 20 feet northwest of, in top of large rock; bronze tablet stamped "W. Va. 1,217" ---------- 1,216.150

Wine Spring School, 0.9 mile northeast of, in front of **Zion Church,** in root of hickory tree; copper nail, painted "1,191.7" ---------- 1,190.86

Wine Spring School, 1.9 miles northeast of, 0.45 mile south of **Peru,** near J. Dasher's residence, on south side of small stream, in root of large tree; copper nail, painted "1,155.1" ---------- 1,154.20

Peru, at northwest corner of flour-mill, in old mill-stone; bronze tablet stamped "W. Va. 1,136" ---------- 1,134.681

Peru, 1.3 miles northeast of, at T road west, on east edge of road, in large rock; chiseled square, painted "1,159.9" --- 1,158.99

Peru, 2.4 miles northeast of, in front of C. Cowger's residence, on west edge of road, in root of large tree; copper nail, painted "1,105.9" ---------- 1,104.98

Peru, 3.5 miles northeast of, at **Blue Rock School,** in east side at southeast corner, in stone foundation; bronze tablet stamped "W. Va. 1,064" ---------- 1,062.885

Peru, 4.6 miles northeast of, 40 feet south of T road west, 10 feet west of highway, in small rock; chiseled square, painted "1,044.9" ---------- 1,044.01

Peru, 5.7 miles northeast of, on west edge of road, in small rock; chiseled square, painted "1,033.7" ---------- 1,032.79

Peru, 6.9 miles northeast of, on South Fork road, at field roads, 40 feet from main road, near field gate, in large boulder; bronze tablet stamped "W. Va. 992" ---------- 991.378

Peru, 7.8 miles northeast of, in front of and opposite S. Ray Ours's residence, on west edge of road, in root of sycamore tree; copper nail, painted "996.9" ---------- 995.98

Peru, 9.0 miles northeast of, in front of G. V. Wolfe's store, at **Bass Post-Office**, 3 feet from northeast corner of wooden bridge over small stream, in root of maple tree; copper nail, painted "984.9" ---------- 983.92

From Rough Run southwest along highways to Klines Crossroads Millgap, thence west to west border of Quadrangle.*

Rough Run School, 1 mile south of, near old barn, 20 feet south of small bridge, on west edge of road, in root of walnut tree; copper nail, painted "1,187.5" ---------- 1,186.68

Rough Run School, 1.9 miles south of, at top of hill, on east edge of road, in root of old oak tree; copper nail, painted "1,263.3" ---------- 1,262.54

Rough Run School, 3.3 miles south of, in east foundation at northeast corner of **Judy School**, in stone; bronze tablet stamped "W. Va. 1,253" ---------- 1,252.645

Rough Run School, 4.1 miles south of, at top of small hill, on east edge of road, in large rock; chiseled square, painted "1,273.7" ---------- 1,272.86

Rough Run School, 5.2 miles south of, 0.25 mile north of sawmill, on west edge of road, in root of large oak tree; copper nail painted "1,374.9" ---------- 1,374.07

Rough Run School, 6.4 miles south of, in doorstep to **Borror School**, in stone; bronze tablet stamped "W. Va. 1,453" -- 1,451.770

Kline, 3.6 miles north of, at top of small hill, on west edge of road, in root of large oak tree; copper nail, painted "1,494.7" ---------- 1,493.90

Kline, 2.5 miles north of, on west end of small wooden bridge in front of Isaac Harmon's residence; copper nail, painted "1,558.5" ---------- 1,557.66

Kline, 2.1 miles north of, at three corners, 80 feet west of forks, on south edge of T road, in large stone; bronze tablet stamped "W. Va. 1,576" ---------- 1,575.344

Kline, 1.1 miles north of, in front of A. O. Lough's residence, on east edge of road, in root of large walnut tree; copper nail, painted "1,591.5" ---------- 1,590.72

Kline, 100 feet northwest of post-office, on east edge of road, in large boulder; chiseled square, painted "1,616.8" ------ 1,616.02

Upper Tract, 3.3 miles east of, at **Klines Crossroads**, on north edge of, 200 feet east of C. A. Mitchell's residence, in large rock; bronze tablet stamped "W. Va. 1.725" ---------- 1,724.528

Upper Tract, 2.7 miles east of, in front of **Schmucker School**, in triangle at three corners, in root of oak tree; copper nail, painted "1,586.9" ---------- 1,586.12

*Line goes to Upper Tract, Onego Quadrangle.

From Klines Crossroads south along highway to south border of Quadrangle.*

Upper Tract, 3.3 miles east of, at **Klines Crossroads**, on north edge of, 200 feet east of C. A. Mitchell's residence, in large rock; bronze tablet stamped "W. Va. 1,725" 1,724.528

Kline, 1.6 miles southeast of, at top of first hill on west edge of road, in root of small pine tree; copper nail, painted "2,188.7" 2,187.86

Kline, 2.6 miles southeast of, on west edge of road, on north edge of lane to Cook's farm, in root of gum tree; copper nail, painted "2,382.7" 2,381.84

From Peru along highways east to Virginia-West Virginia State Line thence southwest along same on ridge to point 3 miles south of Mount Pleasant School, thence west to Lick Run.

Peru, at northeast corner of flour-mill, in old mill-stone; chiseled square, painted "1,135.5" 1,134.60

Peru, 0.8 mile southeast of, in southeast corner of T road south, in root of 10-inch tree; copper nail, painted "1,225.7" 1,224.78

Peru, 2.2 miles southeast of, on Doveville road, 10 feet north of road, in root of 20-inch oak tree; copper nail, painted "1,419.2" 1,418.32

Peru, 2.9 miles southeast of, on Doveville road, at north edge of road, in large boulder; bronze tablet stamped "W. Va. 1,636" 1,635.206

Peru, 3.9 miles southeast of, at point of mountain, on east edge of road, in ledge of rock; chiseled square, painted "2,012.6" 2,011.64

Peru, 4.9 miles southeast of, 0.6 mile west of State line, on northeast edge of road, in ledge of rock; chiseled square, painted "2,392.1" 2,391.18

Peru, 5.5 miles southeast of, on Virginia and West Virginia State line, 100 feet south of road forks, in front of Silas Dove's residence, in large rock near oak tree; bronze tablet stamped "W. Va. 2,424" 2,423.094

Dove triangulation station, 1.8 miles north of, on Virginia and West Virginia State line, at top of **Pine Knob**, 15 feet east of road, in root of oak tree; copper nail, painted "2,747.0" 2,746.03

Dove triangulation station, 0.8 mile east of, at east end of clearing, on south edge of road, in root of oak tree; copper nail, painted "2,841.1" 2,840.19

Dove triangulation station, 100 feet west of John Dove's barn, in small stone; bronze tablet stamped "W. Va. 3,010" 3,009.002

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*Line enters Fort Seybert Quadrangle.

Mount Pleasant School, 100 feet west of schoolhouse, on Virginia-West Virginia State line, in northeast corner of crossing, in root of oak tree; copper nail, painted "2,808.6" ---------- 2,807.66

Mount Pleasant School, 1.2 miles southwest of, on Virginia-West Virginia State line, at driveway to Casper Turner's residence, in northeast corner of forks, in root of large oak tree; copper nail, painted "3,059.8" ---------- 3,058.85

Mount Pleasant School, 2.2 miles south of, on Virginia-West Virginia State line, at sharp bend in road, opposite John Getz's residence, on east edge of road, in root of oak tree; copper nail, painted "3,016.4" ---------- 3,015.39

Mount Pleasant School, 3.0 miles south of, on West Virginia-Virginia State line, at head of Camp Run, in northeast corner of crossroads, 8 feet north of road, in large boulder; bronze tablet stamped "W. Va. 3,017" ---------- 3,015.545

Virginia-West Virginia State line, 0.9 mile west of, on south edge of road, in root of apple tree; copper nail, painted "2,792.0" ---------- 2,791.07

Virginia-West Virginia State line, 1.9 miles west of, at sharp bend in road, on south edge, in root of hickory tree; copper nail, painted "2,180.2" ---------- 2,179.25

South Fork road, at junction of **Camp Run road**, 60 feet south of forks, on east edge of road, in root of locust tree; copper nail, painted "1,427.0" ---------- 1,426.01

Primary leveling by Walter McCrea in 1919:

From Wine Spring School southwest along highways to south border of Quadrangle. (Line enters Fort Seybert Quadrangle.)

Wine Spring School, 20 feet northwest of, in top of large rock; bronze tablet stamped "1,217 W. Va." ---------- 1,216.150

Wine Spring School, 1.1 miles south of, in door-sill of George Dasher's cattle-scales, west side of road; copper nail and washer, painted "T. B. M. 1,283" on building ---------- 1,282.02

Wine Spring School, 2.1 miles south of, 1,500 feet north of B. Souder's gate to dwelling, east side of road, in root of maple tree; copper nail and washer, "T. B. M. 1,297" painted on tree ---------- 1,296.04

Wine Spring School, 3.3 miles south of, at Cyrus Mitchell's barnyard gate, west side of road, in small rock; bronze tablet stamped "1,344 W. Va." ---------- 1,343.308

Wine Spring School, 4.3 miles south of, 105 feet south of intersection of roads, 20 feet east of road, in root of locust tree; copper nail and washer, "T. B. M. 1,427" painted on tree ---------- 1,426.01

ORKNEY SPRINGS QUADRANGLE: HARDY COUNTY.

(Latitude 38° 45'-39°; Longitude 78° 45'-79°).

Third order leveling by F. L. Shalibo in 1919:

From west border of Quadrangle northeast along highways to north border.*

Moorefield, 9.5 miles south of, on South Fork road, on east side of road, 200 feet southeast of J. Parson's residence, in cement wall; bronze tablet stamped "W. Va. 943"------- 942.465

Moorefield, 8.7 miles southwest of, on South Fork road, 300 feet north of farmhouse, at northwest corner of small wooden bridge, in wooden support; copper nail, painted "988.2" -- 987.29

Moorefield, 7.6 miles southwest of, on South Fork road, at crossing of South Fork River, on west side of river, in root of large tree; copper nail, painted "900.3" ---------- 899.34

Moorefield, 6.7 miles south of, on South Fork road, 100 feet east of road, in northwest corner of G. K. Judy's residence, in brick wall; bronze tablet stamped "W. Va. 933"------ 932.097

Moorefield, 5.8 miles southwest of, on South Fork road, at second-class T road east, in root of 14-inch pine tree; copper nail, painted "901.6" -------------------------------- 900.65

Third order leveling by F. L. Shalibo in 1920:

From Moorefield Quadrangle along highways south to Holly Hill Church, thence northwest to Moorefield Quadrangle.

Holly Hill Church, 2.4 miles north of, on Camp Branch road, 300 feet north of farm house, on northeast corner of wooden bridge over small stream; copper nail, painted "1747.1" --1,746.22

Holly Hill Church, 0.9 mile north of, on Camp Branch road, 150 feet south of forks, on east edge of road, in root of 15-inch maple tree; copper nail, painted "1568.2"--------1,567.28

Holly Hill Church, opposite school, 300 feet south of road forks, in center of north foundation wall; bronze tablet stamped "W. Va. 1920 1527" --------------------------1,526.341

Holly Hill Church, 0.6 mile west of, 30 feet south of wooden bridge over small stream, at forks of road, in root of 14-inch maple tree; copper nail, painted "1538.6"----------1,537.70

Holly Hill Church, 2.2 miles northwest of, near George S. Wilt's residence, 60 feet south of small bridge, 20 feet east of road, in root of 10-inch oak tree; copper nail, painted "1780.0" -------------------------------------1,779.13

*Line leaves Petersburg Quadrangle and enters Moorefield Quadrangle.

Holly Hill Church, 3.2 miles south of, 1.7 miles north of top of **Branch Mountain,** on north edge of road, in large boulder; bronze tablet stamped "W. Va. 2064" ____________________2,062.619

Harpers Chapel, 4.8 miles east of, on top of **Branch Mountain,** 15 feet north of road, in root of 15-inch oak tree; copper nail, painted "2,838.3" ____________________2,837.39

Harpers Chapel, 3.4 miles east of, on Branch Mountain, at edge of clearing, on north edge of road, in root of 8-inch oak tree; copper nail, painted "2,324.2"____________________2,323.29

Harpers Chapel, 2.4 miles east of, on Branch Mountain road, at sharp angle, on east edge, on top of large boulder; chiseled square, painted "1759.3" ____________________1,758.32

Third order leveling by E. E. Harris in 1921:

From Holly Hill Church along highways southeast to Lost River, thence southwest up Lost River into Virginia.

Holly Hill Church, 0.6 mile south of, 30 feet south of wooden bridge over small stream, at forks of road, in root of 14-inch maple tree; copper nail, painted "1538.6" ____________________1,537.70

Holly Hill Church, opposite school, 300 feet south of road forks, in center of north foundation wall; bronze tablet stamped "W. Va. 1920 1527" ____________________1,526.341

Witness bench mark, 40.2 feet N. 70° E. of tablet, in top of large stump; copper nail and washer ____________________1,521.95

Holly Hill Church, 0.60 mile east of, 1.96 miles west of **Lost River Post-Office,** on north edge of road, in line with T road south, in east end of north bridge-sill; copper nail and washer, marked "U. S. 1,476.5 B. M." ____________________1,476.53

Holly Hill Church, 1.25 miles east of, 1.29 miles west of **Lost River Post-Office,** on north edge of road, 1 foot south of fence line, in south root of 20-inch maple tree; copper nail and washer, fence marked "U. S. 1432.8 B. M." ____________________1,432.80

Lost River Post-Office, across road from, in pasture, in top of concrete post; bronze tablet stamped "W. Va. 1921 H 59", fence marked "U. S. 1381.1 B. M." ____________________1,381.115

Witness bench mark, 52.4 feet S. 30° E. of tablet, in west root of 12-inch locust tree; copper nail and washer ____________________1,380.05

Lost River Post-Office, 0.83 mile south of, 1.66 miles north of **Lost City Post-Office,** in east edge of road, in west root of 36-inch oak tree, in angle of fence; copper nail and washer, tree marked "U. S. 1425.9 B. M." ____________________1,425.87

Lost City Post-Office, 0.75 mile north of, on west edge of road, 150 feet south of large brick house, 50 feet north of lane, at southwest corner of small wooden bridge; copper nail and washer, fence marked "U. S. 1434.4 B. M." ____________________1,434.40

Lost City Post-Office, 20 feet south of rear end of building, in south end of concrete wall; bronze tablet stamped "W. Va. 1921 H 60," wall marked "U. S. 1482.1 B. M." ____________________1,482.044

Witness bench mark, 47.8 feet N. 25° W. of tablet, in southeast corner of large concrete foundation to gasoline station; chiseled square ---------------------------------1,476.32

Lost City Post-Office, 0.69 mile south of, in north end of southwest wing-wall of iron bridge over **Lost River**; chiseled square, bridge rail marked "U. S. 1447.9 B. M." ----------1,447.82

Water under above bridge at 9 a. m. June 21, 1921 ----------1,435.

Lost City Post-Office, 1.63 miles south of, 2.82 miles north of **Mathias,** on east edge of road, 400 feet north of house, in west root of 22-inch oak tree; copper nail and washer, fence marked "U. S. 1473.1 B. M." ---------------------1,473.06

Mathias, 2.07 miles north of, 20 feet west of road center, on north bank of small run, just north of crossroads, on top of large flint boulder; chiseled square, boulder marked "U. S. 1489.7 B. M." -----------------------------------1,489.62

Mathias, 1.30 miles north of, 150 feet north of T road west, 30 feet west of road center, 40 feet north of Rush Lick Run, in south root of 14-inch cedar tree; copper nail and washer, tree marked "U. S. 1520.2 B. M." -------------1,520.07

Mathias, 0.68 mile north of, 60 feet west of road center, 100 feet south of, in top of concrete post; bronze tablet stamped "W. Va. 1921 H 61", fence marked "U. S. 1550.6 B. M." --1,550.568

Witness bench mark, 29.6 feet S. 25° E. of tablet, in west root of 15-inch walnut tree; copper nail and washer ---------1,546.77

Mathias, center of road, in front of post-office -------------1,526.71

Mathias, 400 feet south of post-office, on east edge of north and south road, south edge of road east, along Upper Cove Run, in angle of concrete wall; chiseled square, telephone-pole marked "U. S. 1531.7 B. M." ----------------------1,531.62

Mathias, 1.03 miles south of, on west edge of road, south side of drain, just south of house, on top of outcrop of rock; chiseled square, fence marked "U. S. 1569.5 B. M."------1,569.37

Mathias, 2.12 miles south of, on north edge of road, 80 feet west of road forks, on top of rock ledge; bronze tablet stamped "W. Va. 1921 H 62" ledge marked "U. S. 1598.9 B. M." --1,598.771

Witness bench mark, 15.7 feet S. 5° W. of tablet, on small boulder; chiseled square ------------------------------1,597.56

Mathias, 2.66 miles south of, on west edge of road, north edge of T road west, on top of outcrop of rock; chiseled square, mail-box post marked "U. S. 1615.5 B. M." -------------1,615.33

Mathias, 3.69 miles south of, on east edge of road, 10 feet south of door to large barn, in south root of 15-inch apple tree; copper nail and washer, barn marked "U. S. 1680.5 B. M." ---1,680.34

Mathias, 4.66 miles south of, 50 feet east of road center, 30 feet south of second-class road east, in west root of 6-inch ash tree; copper nail and washer, tree marked "U. S. 1723.5 B. M." ---------------------------------------1,723.38

Mathias, 5.42 miles south of, on west edge of road, in concrete foundation at northeast corner of house of B. H. Cullers; bronze tablet stamped "W. Va. 1921 H 63", fence marked "U. S. 1691.1 B. M." -----------------------------------1,690.945

Witness bench mark, S. 50° E. of tablet, on top of boulder; chiseled square --1,691.40

Mathias, 6.39 miles south of, on west edge of road, 80 feet south of lane northeast to farm house, on top of boulder; chiseled square, boulder marked "U. S. 1609.5 B. M."------1,609.30

Mathias, 7.06 miles south of, on West Virginia State line, on east edge of road, in east root of 12-inch locust tree; copper nail and washer, fence marked "U. S. 1540 B. M."----1,539.82

EDINBURG QUADRANGLE: HARDY COUNTY.

(Latitude 38° 45′-39°; Longitude 78° 30′-78° 45′).

Third order leveling by E. E. Harris in 1921:

From Wardensville Quadrangle south along highways in northwest part of Quadrangle. Spur line leveled twice.

Perry Post-Office, 2.33 miles north of, on west edge of road, 15 feet north of small wooden bridge over drain, in top of oak stump; copper nail and washer, marked "U. S. 1,568.5 B. M." --1,568.47

Perry Post-Office, 1.46 miles north of, on east edge of road, 60 feet south of drain crossing, in east root of 20-inch oak tree; copper nail and washer, tree marked "U. S. 1,725.1 B. M." ------------------------- ---------------------1,725.02

Perry Post-Office, 1.06 miles north of, on south edge of road, in line with T road north, in gap, on top of large boulder; chiseled square, boulder marked "1,865.7"--------------1,865.63

Perry Post-Office, 0.77 mile north of, 400 feet north of **Fairview School,** on west edge of road, in west end of wooden culvert; copper nail and washer, fence marked "U. S. 1,731 B. M." --1,730.90

Perry Post-Office, 100 feet northeast of, 50 feet east of road center, on west edge of apple orchard, in center of top of large boulder; bronze tablet stamped "1722 H 57 1921 W. Va.", fence marked "U. S. 1,722.2 B. M." -----------1,722.091

Witness bench mark, 46.8 feet S. 45° W. of tablet, on top of large boulder; chiseled square ---------------------------1,723.82

Perry Post-Office, 0.91 mile south of, 0.16 mile north of **Mount Vernon Church**, on east edge of road, 20 feet south of lane southeast through gate, on top of boulder; chiseled square, marked "U. S. 1,847.6 B. M." ---------------------1,847.48

Perry Post-Office, 1.51 miles south by 0.51 mile north of **Rockland Post-Office** (now discontinued), on east edge of road and north edge of lane east through gate, on top of boulder; chiseled square, fence marked "U. S. 1,925.6 B. M." ---1,925.50

Rockland Post-Office, (now discontinued), 0.10 mile south of, 30 feet east of road center, 23 feet north of northeast corner of **Rockland School**, in top of large boulder; bronze tablet stamped "H 58 1921 W. Va. Elev. 1922", boulder marked "U. S. 1,922.5 B. M." ----------------------------1,922.398

Witness bench mark, 23 feet south of tablet, on top of rock, at northeast corner of **Rockland School**; chiseled square--1,919.89

APPENDIX "B'

ROAD MATERIAL TESTS, ANALYSES, SURVEYS, ETC.

BY TESTING DEPARTMENT OF THE STATE ROAD COMMISSION,

PUBLISHED THROUGH THE COURTESY OF
FRED A. DAVIS AND R. B. DAYTON,
MORGANTOWN, W. VA.

COMPILED BY
R. C. TUCKER, ASSISTANT GEOLOGIST.

Road Material Tests, Grant County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
695*	Petersburg	2.68	167.15	0.38	6.83	18.37	40				LS	Concrete
1020*	Arbogast property							14				Macadam
444	Geo. Yokum property	2.53	157.56		4.12	19.18				3015	SS	Concrete
1111	Project: 3149	2.59	161.6	1.15	3.06					3149	SS	Base course
1112	Project: 3149 Sta. 126	2.72	169.4	0.30	6.72					3149	SS	Base course
1113	Project: 3149 Sta. 38	2.25	140.7	3.02	10.3					3149	SS	General use
1878						See chemical analysis						
2151	E. W. Smith	2.66	165.7	0.6	1.26					3146	SS	General use
2152	Keplinger property	2.72	169.7		4.00					3146	LS	General use
2153	Fred Hess property	2.53	157.9	1.96	2.36					3146	SS	General use
2154	John Burgess	2.37	147.9	2.9	9.38					3146	SS	General use
2155	Edith Day property	2.60	161.9	0.98	3.4					3146	SS	General use
2156	May's Estate	2.61	163.2	0.80	4.5					3146	SS	General use
3455	Romney, W. Va. (?)	2.73	170.36	Soundness O. K. see card for analysis						Br. 831	LS	Concrete
4116	Petersburg, W. Va.	2.59	161.62	0.9	2.06					3146	Ck. Gravel	
4256	R. Lickens	2.505	156.31	2.3	See card for analysis					122B	SS	All classes of concrete
4257	Mineral Co. Quarry (?)	2.71	169.11		See card for analysis					122A	LS	All classes of concrete
4466	Johnnycake Run	2.585	161.31	3.1	3.18					122B	SS	Concrete
4797	400 ft. left Sta. 3	2.51	156.62	3.2	3.94					122C	SS	Concrete
5079	Sta. 163	2.61	162.87	1.1	2.88					122C	SS	A. B. C. Concrete
5147	Sta. 552 plus	2.515	156.93	1.8	4.18	See card for analysis				122B	SS	
5254	Sta. 273	2.53	157.87	2.9	3.58					122C		A. B. C. Concrete
5327	Sta. 160	2.59	161.62	2.0	4.42					122C	SS	Concrete
5328	Sta. 160	2.58	161.00	2.1	3.54					122C	SS	Concrete
5809	Sta. 600 Proj. 122B	2.58	161.00	2.3						122B	SS	Coarse agg. in concrete
6007	Clay Riel	2.44	152.25	3.3	6.36					122C	SS	Coarse agg.
6034	Clay Riel	2.57	160.00	2.6						122C		Coarse agg.
6825	Maidsville, W. Va. (?)	2.47	154.12	2.3	2.70					3215		Rip Rap
7070	Wm. Stagg, Sta. 495	2.42	151.00	2.9	3.98					122B	SS	Coarse agg.
7481	Petersburg, W. Va.	2.67	Mech. & Chem. anal.							831&3149		Concrete
7500	Scott Hall property	2.655	165.67		2.00					884&3186		
7582	Scott Hall property	2.65	165.36		1.28					884&3146		Concrete

*Old Series Nos. SS=Sandstone. LS=Limestone.

Road Material Tests, Grant County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
8084	Mt. Storm, W. Va.	2.54	158.50		6.36					122B	SS	Concrete
8271	Mt. Storm, W. Va.	2.51	156.62		7.06					122B	SS	A. & B. Concrete
9865	Petersburg, W. Va.	Mechanical analysis								70-990		A. & B. Bri.
10426	S. R. C.—J. R. Shaffer, Gormania, W. Va.	2.57	160.68		1.88					122C	SS	P39-39A&52A
10427	S. R. C.—Homer Foley, Gormania, W. Va.	2.51	156.62		5.80					122C	SS	P39-39A&52A
10428	S. R. C.—H. C. Reed, Gormania, W. Va.	2.55	159.12		2.88					122C	SS	P39-39A&52A
10429	S. R. C.—J. W. Lee, Gormania, W. Va.	2.565	160.06		2.52					122C	SS	P39-39A&52A
10647	R. of W. near Maysville, W. Va.	2.575	160.68		1.10					3215A	SS	Coarse agg. for concrete
10742	Local	2.62	163.49		1.58					3215A	SS	Base concrete Ag.
11421	Jno. Lee, Gormania, W. Va.	Shale-Cement value						33.3		122C-Sect. 1	Shale	Binder Knap. BC
11624	Jno. Lee, Station 150	Shale—Soundness unsatisfactory								122C	Shale	Chem. anal.
11687	Dunkard Church, Sta. 118/50	Shale								3215A	Shale	Surfacing
11757	Monon. Constr. Co., Bowden, W. Va.	Limestone Chips—grading only								122C	LS	Item 50
11758	Monon. Constr. Co., Bowden, W. Va.	Intermediate Stone—grading only								122C	LS	Item 50
12313	Sta. 136-138	Shale								3215A	Shale	Surfacing
12360	Hamlin Brothers, Gormania, W. Va.	2.53	157.87		4.16				17,850	122C	SS	Bit. Mac. Base
12511	Hamlin Brothers, Gormania, W. Va.	2.54	158.50		2.00				20,500	122C	SS	Knapped B. Coarse
12512	Hamlin Brothers, Gormania, W. Va.	2.49	155.37		4.40				16,230	122C	SS	Item 39A
12513	Hamlin Brothers, Gormania, W. Va.	2.51	156.62		5.40				15,200	122C	SS	Item 39A
12605	Project 3146	Mechanical analysis only								3146	Shale	Mech. anal.

Road Material Tests, Mineral County, by Testing Department, State Road Commission.

Specific Gravity	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
326	Keyser	2.75	171.28		5.86	17.76	9.5				LS	General use
357	Standard L. & S. Co.	2.70	168.17		2.48	17.13	5.5				LS	General use
398	County Quarry Site	2.61	162.86						7 day-2018	1-2-4		
1356	Adam Prospect	2.70	168.8		4.40				28 day-3420	3144	LS	Concrete
1357	C. W. Thompson	2.58	160.7	0.15	3.76					3144	SS	Concrete
1927	Wm. Farris property	2.58	161.0	0.76	7.40					3107	SS	Conc. & Mac.
1928	C. R. Long property	2.38	148.5	1.90	6.08					3107	SS	General use
1929	C. H. Long property	2.70	168.5		5.00					3107	LS	General use
1966	J. E. Leps				7.26	gray					SS	
		2.35	146.6	2.50	30.70	brown				3010	LS	Concrete
2022	Mineral Co. Quarry	2.71	169.1		4.88						LS	Concrete
2854	Standard L. & S. Company	2.72	169.7		3.06						LS	General use
2855	Standard L. & S. Company	2.74	171.3		1.80							General use
3153	Burlington, W. Va., Abut. Old Bridge	2.705	168.80						23,800			Class B. Conc.
3247	New Creek, W. Va.	2.740	170.98		3.58					122A	LS	Conc. & Mac.
3282	Gormania, W. Va.	2.565	160.05		3.76					122B&C	SS	Conc. Work
3285	Gormania, W. Va.	2.445	152.56		3.10					122B&C	SS	Concrete
3286	Gormania, W. Va.	2.525	157.56		3.74					122B&C	SS	Concrete
3634	Gormania, W. Va.	2.495	155.68	2.10	4.86					122B&C	SS	Concrete
4102	Mineral Co.	2.75	171.60		3.34	Soundness O. K.				3010	LS	Base Course
4103	Mineral Co.	2.73	170.36		3.48	Soundness O. K.				3010	LS	Base & Top Course
4104	Arnold Property, Burlington, W. Va.					See card for analysis				3010	LS	W. B. Mac.
4140	Alaska, W. Va.	2.485	155.06	1.42	3.64					3107	SS	Concrete
4724	Alaska, W. Va.	2.63	164.12	0.8	3.36	See card for analysis				3107	SS	A. B. C. Conc.
5122	Mineral Co. Crusher	2.675	166.92			Soundness O. K.				122A	LS	Conc. A. B. C.
6277	Mineral Co. Quarry					See report for Mech. anal.				3010	LS	Concrete
7168	Station 410, Hartmansville	2.575	160.68	1.6	4.98					122A	SS	W. B. & Bit. Mac.
7169	Station 166, Hartmansville	2.64	164.74	1.3	3.26					122A	SS	W. B. & Bit. Mac.
7170	Station 333, Hartmansville	2.58	161.0	2.1	4.78					122A	SS	W. B. & Bit. Mac.
7171	Station 256, Hartmansville	2.47	154.12	2.6	8.68					122A	SS	W. B. & Bit. Mac.
7172	Station 362, Hartmansville	2.65	165.36	1.0	2.80					122A	SS	W. B. & Bit. Mac.
7173	Station 398, Hartmansville	2.57	160.37	1.8	3.50					122A	SS	W. B. & Bit. Mac.
7174	Station 256, Hartmansville	2.425	151.31	3.1	14.80					122A	SS	W. B. & Bit. Mac.
7319		2.72	169.73		2.74					122A		Base Bit. Mac.
7320	C. W. Thompson, Claysville, W. Va.	2.73	170.36		4.80					122A		Top & Base Mac.
7321	Samuel Ward, Claysville, W. Va.	2.51	156.62	1.4	5.60					122A	SS	Base for Mac. & Conc. Agg.
7322	E. Shillingburg, Elk Garden, W. Va.	2.615	163.18	0.8	2.615					122A	SS	Base for Mac. & Conc. Agg
7323	Samuel Ward, Claysville, W. Va.	2.735	170.67		1.64					122A		Top for Bit. Mac.
7324	E. Sbillingburg, Elk Garden, W. Va.	2.54	158.50		2.34					122A	SS	Base Bit. Mac. Pave

Road Material Tests, Mineral County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
7325	C. W. Gumm Heirs, Claysville, W. Va.	2.60	162.24		2.10					122A	SS	Base Bit. Mac. Pave
8143	Claysville, W. Va.	2.605	162.55		5.20					122A	SS	Base
8144	Claysville, W. Va.	2.33	145.39		8.00					122A	SS	Base
8145	Claysville, W. Va.	2.52	157.25		12.18					122A	SS	Base
8676	Claysville, W. Va.	2.565	160.06		4.04					122A	SS	Knap. St. Base
8677	Claysville, W. Va.	2.425	151.31		18.72					122A	SS	Knap. St. Base
8678	Claysville, W. Va.	2.405	150.07		2.90					122A	SS	Knap. St. Base
9412	Piedmont, W. Va.	2.555	159.43		5.00					970	SS	A. & B. Conc.
9413	Piedmont, W. Va.	2.56	159.74		4.78					970	SS	A. & B. Conc.
9449	Martinsburg, W. Va.	2.695	168.17		Mech. anal.					970	LS	A. & B. Conc
9680	Bloomington, Md.	2.59	161.62		4.80				Br.	970	SS	A. & B.
9964	Westernport, Md.	2.50	168.00		Mech. anal.					970	LS	Bridge
10451	J. R. McDermott, Keyser, W. Va.							C.V.- 70		3010	Shale	Shale Surfacing
10452	S. R. C.—Sta. 150							C.V.- 81		3010	Shale	Shale Surfacing
10453	S. R. C.—Sta. 50							C.V.- 66		3010	Shale	Shale Surfacing
10454	S. R. C.—Sta. 505							C.V.-152		3010	Shale	Shale Surfacing
10455	S. R. C.—Sta. 410							C.V.-174		3010	Shale	Shale Surfacing
10456	S. R. C.—Sta. 51-72							C.V.-115		3010	Shale	Shale Surfacing
10457	S. R. C.—Sta. 360							C.V.-104		3010	Shale	Shale Surfacing
10767	Geo. Sievers, Hartmansville, W. Va.	2.605	162.55		3.1	(determined on 35000 gram sample)				122A	SS	Items 39 & 52A
10768	E. D. Shillingburg, Hartmansville, W. Va.	2.47	154.12		10.48					122A	SS	Items 39 & 52A
10810	Shillingburg—near Hartmansville	2.505	156.31		3.26					122A-Sec. 2	SS	Items 39 & 52A
10811	Shillingburg—near Hartmansville	2.55	159.43		1.78					122A-Sec. 2	SS	Items 39 & 52A
10811	Shillingburg—near Hartmansville	2.56	159.71		2.14					122A-Sec. 2	SS	Items 39 & 52A
10813	Shillingburg—near Hartmansville	2.55	159.12		2.18					122A-Sec. 2	SS	Items 39 & 52A
10814	Shillingburg—near Hartmansville	2.56	159.74		2.40					122A-Sec. 2	SS	Items 39 & 52A
10815	Sam Ward, Claysville, W. Va.	2.72	169.73		2.08					122A-Sec. 2	SS	Items 39 & 52A
10816	Sam Ward, Claysville, W. Va.	2.50	156.00		8.20					122A-Sec. 2	SS	Items 39 & 52A
10905	Sam Ward, Claysville, W. Va.	2.46	153.49		10.32					122A-Sec. 1	SS	Item 52A
10906	Sam Ward, Claysville, W. Va.	2.345	151.93		18.10					122A-Sec. 1	SS	Item 52A
11250	Cosner's Gap, near Maysville, W. Va.	2.64	164.74		1.44					3215	SS	Macadam
11285	Rexroad Mines, Sulphur, W. Va.	Shale						C.V.-33(?)		122A sheet 2	Shale	Filler Base C.
11410	Std. L. & S. Co., Martinsburg, W. Va.	2.71	169.11		O. K.					Bri. 970	LS	Use in bridge
11608	J. R. Shaffer, near Germania, W. Va.	2.61	162.87		2.84				12,460	122 D. C.	SS	52A & Compression
11623	Vincennes Bridge Co., Piedmont, W. Va.....	Limestone Chips—grading only								B970	LS	Conc. Floor
11996	T. T. Hoffman, Keyser, W. Va.	2.04	127.5		10.14					County	SS	Conc. & Top Chips
12016	Local	2.55	159.12		17.22					135A	SS	Base Course
12242	Jno. Kitzmiller, Blaine, W. Va.	2.50	156.00		4.68					1119	SS	Base & Top
13799	Ridgeley, W. Va.	2.63	164.12		3.6				23,000	73	SS	Bit. Mac. A. B. C. Concrete

C. V.=Cementing Value.

Road Material Tests, Pendleton County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
2759	D. F. Bowers	2.72	169.7		3.00					3175	LS	General use
2760	J. K. Kee	2.55	159.9	1.62	2.24					3175	SS	General use
3048	Dice Prop., Franklin, W. Va.	2.35	147.0	4.30	22.66					3142	SS	Masonry
3461	Upper Tract, W. Va.	2.68	167.24		1.98	Soundness O. K.				Br. 876	LS	Concrete
4323	Circleville, W. Va.	2.66	165.99		6.28					3175	LS	Concrete
5203	Upper Tract, W. Va.	2.705	168.79		2.50	Soundness O. K. see card for analysis				3014 & 876	SS	B. Conc.
5282	G. W. Hammer	2.60	162.24		6.76	Soundness O. K.				3142A	LS	B. A. Conc.
5430	C. N. Judy	2.685	167.55		2.22	See card for analysis				3014	Cal. SS	Class B. Conc.
7302	B. H. Hiner, Franklin, W. Va.	2.415	150.69	4.1	17.72					3175B	SS	Agg. for Conc.
7401	Franklin, W. Va.	2.72	169.73		2.32					3142A	LS	Mac. Surf.
7527	P. Boggs property	2.63	164.12		2.78					3142A	SS	A. & B. Conc.
9130	....	2.51	156.62		Mech. anal.					3175B	SS	A. B. C. Culverts
11409	Right of Way	2.63	164.12		1.64					3175B	SS	General
13080	J. E. Moyers, Franklin, W. Va.	2.65	165.36		3.6					3213A	SS	A. B. & C. Conc.
13806	R. of W.	2.58	161.00		3.4					3175C	SS	A. B. & C. Conc.

Road Material Tests, Hardy County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
1066*	Cunningham property				3.3						R. Boulders	
327		2.76	172.22		2.44	17.90	16			3014	LS	General use
328		2.60	162.55		3.04	19.19	24.5			3014	SS	General use
1463	Geo. Eberly	2.61	162.9	0.6	5.3					3148	SS	Sound
1464	Geo. Eberly	2.71	169.1		3.72					3148	LS	Sound
1465	Geo. Eberly	2.58	161.0	0.77	3.00					3148	SS	Sound
1466	W. Wotton	2.54	158.8	0.75	4.00					3148	SS	Sound
1879						See Chemical Analysis						
1881						See Chemical Analysis						
3268	Welton, W. Va.	2.52	157.25	1.42						3148	River Rock	Drainage Struc.
3405	Moorefield, W. Va.	2.60	162.24	1.2	3.48					3214A	SS	Conc. Masonry
3496	Durgon, W. Va.	2.54	158.81	2.00	1.96	See card for analysis				3148	SS	Bridges
4179	Moorefield, W. Va.	2.57	160.37	1.1	4.56					62	SS	Bit. Mac.
4180	Moorefield, W. Va.	2.625	163.80	0.5	1.48					62	SS	Bit. Mac.
4181	Moorefield, W. Va.	2.56	159.74	1.3	3.30					62	SS	Bit. Mac.
4406	Moorefield, W. Va.	2.60	162.24	1.2	3.48					62	River St.	Surfacing
4447	Durgon, W. Va.	2.57	160.37	1.40		See card for analysis				3148	SS	
4841	Reynolds Gap, W. Va.	2.61	162.87	1.3	3.14					3013	SS	Top Course
5416	Greenwalt Sr.	2.51	156.62	1.2	3.18					3013	SS	Base Course
5417	C. N. Fout	2.49	155.37	2.1	2.74					3013	SS	Base Course
5418	Greenwalt Sr.	2.525	157.56	2.1	9.48					3013	SS	Base Course
7303	W. A. Harper, Moorefield, W. Va.	2.67	166.61	0.8	1.60					3148	Gr.	Slab Mac.
7304	L. Fisher, Moorefield, W. Va.	2.71	169.11		3.80					3148	LS	Slab Mac.
7305	Geo. Eberly	2.695	168.17		7.94					3148	LS	W. B. Mac.
7387	Moorefield, W. Va.	2.65	165.56		8.50					3148	SS & C SS	W. B. Mac. & Bit. Mac.
7388	Moorefield, W. Va.	2.54	158.50	2.4	7.40					3148	SS	W. B. Mac. & Bit. Mac.
7389	Moorefield, W. Va.	2.535	158.18	1.5	5.00					3148	SS	W. B. Mac. & Bit. Mac.
10078	Moorefield, W. Va.	2.56	159.74		2.80					3214	SS	Concrete
10080	Moorefield, W. Va.	2.595	161.93		2.20					3214	SS	Concrete
10459	S. R. C.—Sta. 620							C.V. unable to deter.		3013	Shale	Shale Surfacing
10460	S. R. C.—Sta. 556							C.V.-41		3013	Shale	Shale Surfacing
10461	S. R. C.—Sta. 702							C.V.-45		3013	Shale	Shale Surfacing
10465	S. R. C.—Sta. 589							C.V. unable to deter.		3013	Shale	Shale Surfacing
11442	Sta.-50 plus 100	Shale								3214A	Shale	Chem. Anal.

*Old Series Nos.

Road Material Tests, Hampshire County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
862*	Triplett property	2.66	166.30	0.77	3.14	17.06	14				SS	Macadam
863*	Shan property	2.68	167.50		2.77	13.43	7				SS	Macadam
1146*	Sanders property	2.52	157.20		4.5	17.15	11.0			72	SS	W. B. Mac.
406	Mechanicsburg	2.43	151.63		2.96	18.28	8			3011	SS	Concrete
407	Mechanicsburg	2.61	162.86		3.54	19.20	7			3011	LS	Concrete
769	P. 72A, Sta. 216	2.67	166.61	0.03	3.06	18.14	26.0			72A	SS	General use
1167	Hampshire Co.	2.65	165.4	0.10	3.86					3011	SS	General use
1706	I. Biser, Junction, W. Va.	2.71	169.1		3.56					802 & 3011B	SS	General use
1707	I. Biser, Junction, W. Va.	2.68	167.2		5.60						SS	Concrete
1846	E. W. Dolan	2.70	168.5	0.82	1.84					3147	SS	General use
1948	D. V. P. Pancake	2.64	164.7	1.1	3.36					3147	SS	General use
1970	W. P. Russell	2.67	166.3	0.10	3.8					3012		General use
1971	Geo. Taylor	2.62	163.5	0.10	4.52					3012	LS	General use
2317	F. Pugh property	2.40	149.7	3.4	7.52					3147	SS	Concrete
2318	F. Pugh property	2.53	157.9	2.42	7.22					3147	SS	Concrete
2319	Hanging Rock	2.61	162.9	0.6	4.54					3147	SS	Concrete
2526	J. Rogers	2.71	169.1	0.06	1.5					3147	SS	General use
2527	J. Rogers	2.62	163.5		6.2					3147	R. Gavel	Concrete
2571	Molly Pavill	2.62	163.5	1.29	2.00					3147	SS	Base C.
2574	S. Taylor property	2.57	160.4		2.98						LS	W. B. Mac.
2575	S. Taylor property	2.76	172.2		3.32						LS	W. B. Mac.
2576	S. Taylor property	2.74	171.3		4.06						LS	W. B. Mac.
2601	Saville property	2.70	168.5	0.73	3.76					3147		Concrete
2603	Stewart property	**2.66**	**166.0**	0.80	**2.40**					3147		Base
2923	P. 3173, Sta. 709	2.61	163.2			See card				3173	Shale	Surfacing
3188	H. Clower property	2.31	143.14	2.76	12.50					3011	SS	Bit. Mac.
3189	H. Clower property	2.625	163.80		1.68					3011	SS	W. B. Mac.
3436	Pleasantdale, W. Va.	2.63	164.12	1.60	2.60					3147A	SS	Concrete
3438	Capon Bridge, W. Va.	2.61	162.87	0.82	6.96					3173	SS	Sub Base
3449	Capon Bridge, W. Va.	2.59	161.62	1.43	2.06					3173	SS	Concrete
3450	Capon Bridge, **W. Va.**	2.55	159.12	1.86	7.46					3173	SS	Bridge Work
3977	Sta.—5-9	2.325	145.08	3.96	11.04					3011B	SS	Bk. St. & W. B. Mac. Sur.
3978	Roadside	2.635	164.43		1.92					3011B	LS	Bk. St. & W. B. Mac. Sur.
3979	Sta. O	2.355	146.95	3.4	4.98					3011B	SS	Bk. St. & W. B. Mac. Sur.
4142	Purgitsville, W. Va.	2.52	157.25	1.62	3.92					3012	SS	Bridges, etc.
4143	State Quarry	2.755	171.91		3.26	Soundness O. K. see card for analysis				3012	LS	Bridges, etc.
4178	Junction, W. Va.	2.70	168.48	0.6	3.36					3012	SS	Rip Rap
4311	S. R. C. Sta. 242	2.57	160.31			See card for analysis				3147A	Cr. Stone	Class A. Conc.
4514	Mechanicsburg Gap	2.41	150.38	3.8	8.30					3011B	SS	Broken St.
4515	Vanderlip, W. Va.	2.76	172.22		7.04	Soundness not O. K.				3011A	Shale	Mac. Surf.

*Old Series Nos.

Road Material Tests, Hampshire County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
4516	Vanderlip, W. Va.	2.69	167.87		3.52	Soundness O. K. 60.5				3011A	Calc. SS	Mac. Surf.
4639	Pleasantdale, W. Va.	2.665	166.30	0.8	2.68	Soundness O. K. see card for analysis						
4692	State Quarry	2.73	170.36		4.00	Soundness O. K.				3147A	LS	Class A Conc.
4693	Purgitsville, W. Va.	2.535	158.19	1.4	4.04					3012	LS	Bridges
		2.31	144.14							3012	SS	Bridges
4785	Mechanicsburg Gap	2.67	166.61	4.2	10.30					3011B	SS	Base Course
4880	Sta. 242, Proj. 3147A	2.59	161.62	1.3	2.32	See card for analysis				3147A	SS	Class A Conc.
4992	H. O. Clower	2.31	144.14	4.4	10.10					3011B		Base Course
4993	J. H. Parker	2.45	152.87	2.8	21.12					3011B		Base Course
5056	Mechanicsburg Gap	2.70	168.48		5.38	Soundness O. K.				3011B	Flint	Base Course
		2.35	146.64									
5284	Mechanicsburg Gap	2.64	164.74	3.4	3.78					3011B		Base Surf. & W. B. Mac.
5285	Mechanicsburg Gap	2.66	165.99		4.24					3011B	Cal. SS	Base Surf. & W. B. Mac.
5429	Taylor property	2.475	154.43	1.8	9.64					3012	SS	Slab Bri.
5656	Taylor property, Rada, W. Va.	2.51	156.62	1.4		See Report for Mech. Anal.				3012	SS	Slab on Bri.
5657	Biser Prop., Junction, W. Va.	2.50	156.00	1.1		See Report for Mech. Anal.				3012	SS	Slab on Bri.
5658	Jno. Veach, Purgitsville	2.61	162.87	1.2	5.38					3012	SS	Headwall & Pipe Culvert
5894	Sta. 60 to Sta. 70	2.55	159.12	2.1	8.54	See Report for Mech. Anal.				3011B	SS	Base & Top W. B. Mac.
6866	S. Taylor—Sta. 0-50	2.77	172.84		2.14	Soundness O. K. about 71% $CaCO_3$						
7102	S. Taylor, Mechanicsburg Gap, W. Va.	2.635	164.43		4.12					3011B	SS	W. B. Mac. Top & Base
7103	S. Taylor, Mechanicsburg Gap, W. Va.	2.57	160.37	1.3	4.78					3011B	SS	W. B. Mac.
7104	S. Taylor, Mechanicsburg Gap, W. Va.	2.54	158.50		4.54					3011B	SS	Top & Base Mac.
7105	Sta. 293 plus 40	2.67	166.61		2.60					3011B	SS	Top & Base Mac.
7110	Rt. of Way Sta. 232	2.68	167.24		2.40					72	SS	Base
7233	Sirbough, Capon Bridge	2.435	151.93	4.3	15.60					3147A	Cr. St.	Culverts
7234	F. Schoffenaker, Capon Bridge	2.53	157.87	3.6	10.94					135B	SS	W. B. (ABC)
7236	Mrs. Webster, Capon Bridge	2.59	161.62	2.3	6.16					135B	SS	W. B. (ABC)
7237	F. Schoffenaker, Capon Bridge	2.41	150.38	3.3	11.30					135B	SS	W. B. (ABC)
7280	Omar Williamson, Coldstream, W. Va.	2.72	169.73		2.94	($CaCO_3$ 69.3 $MgCO_3$ 14.15)				135B	SS	W. B. (ABC)
7281	B. V. Pancake, Pleasantdale, W. Va.	2.655	165.67	0.9	2.68					135	LS	Mac. & Agg.
7282	J. Rogers, Hanging Rock, W. Va.	2.72	172.72		3.40	($CaCO_3$ 50.0 $MgCO_3$ 24.1)				134	LS	Mac. & Agg.
7283	E. P. Hiett, Pleasantdale, W. Va.	2.625	163.80	0.9	2.50					135	SS	Mac. & Agg.
7284	J. Rogers, Hanging Rock, W. Va.	2.65	165.36	1.2	2.16					134	SS	Mac. & Agg.
7285	E. P. Hiett, Pleasantdale, W. Va.	2.665	166.30		2.80	Soundness O. K.				134	SS	Mac. & Agg.
7531	S. Taylor property	2.72	170.05		4.92	(Chem. anal.)				134	SS	Mac. & Agg.
7532	S. Taylor property	2.725	170.36		5.38	(Chem. anal.)				3011B	SS	Base & Top W. B. Mac.
7554	J. S. Taylor	2.710	169.11		7.00	(Chem. anal.)				3011B	LS	Base & Top W. B. Mac.
7774	Mechanicsburg Gap	2.73	170.98		4.24	(Chem. anal.)				3011B	LS	Mac.
7989	Pleasantdale, W. Va.	2.53	157.87		2.22					3011B	LS	Base & Top W. B. Mac.
7990	Pleasantdale, W. Va.	2.51	156.62		2.92					134	LS	Bri. & Culverts
7991	Pleasantdale, W. Va.	2.525	157.25		3.14					134	SS	Bri. & Culverts
										134	SS	Bri. & Culverts
8162	Mechanicsburg Gap	2.73	170.36		4.42	(Chem. anal.)				3011B	SS	Top W. B. Mac.

Road Material Tests, Hampshire County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
9822	Hanging Rock, W. Va.					(Mech. anal.)				670-134	LS	Chips-Bridge
9869	Mechanicsburg Gap	2.61	162.87		2.40	(Chem. anal.)				3011B	SS	General
10411	B. F. Stewart, Hanging Rock, W. Va.	2.51	156.62		4.32					135A	SS	Blt. Mac.
10412	B. F. Stewart, Hanging Rock, W. Va.	2.56	159.74		1.96					135A	SS	Base Course
10413	B. F. Stewart, Hanging Rock, W. Va.	2.59	161.62		1.06					135A	SS	Base Course
10414	E. G. Emmett, Hanging Rock, W. Va.	2.51	156.62		2.22					135A	SS	Base Course
10415	E. G. Emmett, Hanging Rock, W. Va.	2.535	158.19		2.20					135A	SS	Base Course
10458	G. N. Arnold, Station 320							C. V.-92		3012	Shale	Shale Surfacing
10462	S. R. C.—Sta. 67							C. V.-84		3012	Shale	Shale Surfacing
10463	S. R. C.—Sta. 397							C. V.-39		3012	Shale	Shale Surfacing
10464	S. R. C.—Sta. 200							C. V.-33		3012	Shale	Shale Surfacing
10494	Sam Parks—Loom, W. Va.	2.34	146.01		52.00					135A	SS	Base Course
10495	Sam Parks—Loom, W. Va.	2.62	163.49		2.30					135A	SS	Base Course
10496	Gilbert McCauley, Loom, W. Va.	2.52	157.25		5.70					135A	SS	Base Course
10497	E. G. Emmett, Loom, W. Va.	2.675	166.92		1.80					135A	SS	Base Course
10699	Ben Stewart, Hanging Rock, W. Va.	2.57	160.37		2.32					135A	SS	Bit. Mac. A. & B. Conc.
10793	Ben Stewart, Hanging Rock, W. Va.	2.515	156.93		8.80					135A	SS	General use
10794	E. G. Emmett, Hanging Rock, W. Va.	2.595	161.93		2.84					135A	SS	Bit. Mac. & Conc.
10795	Ben Stewart, Hanging Rock, W. Va.	Same as No. 10699—Mechanical analysis only								135A	SS	Bit. Mac. & ABC Conc.
10886	Ben Stewart, Hanging Rock, W. Va.	2.69	167.86		2.76	Calcium Carbonate 93.0%				135A	LS	Base Course
10887	Ben Stewart, Hanging Rock, W. Va.	2.60	162.24		2.74					135A	SS	Base Course
10915	Gates & Bailey, Elkins, W. Va.	2.72	169.73		O. K.	Calcium Carbonate 62.7%				3011B	LS	A. B. Conc.
10916	J. N. Phares, Gilmer, W. Va.	2.56	159.74		3.64					3011B	SS	Base Course
11079	E. G. Emmett, Loom, W. Va.	2.45	152.87		O. K.					135A	SS	A. & B. Conc.
11080	E. G. Emmett, Loom, W. Va.	2.61	162.87		2.04					135A	SS	A. B. Conc.
11147	Std. Lime & Stone Co., Martinsburg, W. Va.	2.70	168.48		O. K.	$CaCO_3$—65%				3011B	LS	Chips-Bit. Mac.
11286	Std. Lime & Stone Co., Martinsburg, W. Va.	2.71	169.11		O. K.					3011A	LS	Blt. Mac.
11357	Std. Lime & Stone Co., Martinsburg, W. Va.				O. K.					3011A	LS	Blt. Mac.
11534	Std. Lime & Stone Co., Martinsburg, W. Va.	Grading only								3011A	LS	Item 52A
11827	Ben Stewart, Hanging Rock, W. Va.	2.70	168.48		2.52	$CaCO_3$—89%				135A	LS	Blt. Mac.
11828	J. E. Romesburg, Hanging Rock, W. Va.	Crushed sandstone for grading only								135A	SS	Base C. Filler
11829	Ben Stewart, Hanging Rock, W. Va.	2.72	169.37		2.20	$CaCO_3$—61.5%				135A	LS	Bit. Mac.
12044	E. G. Emmett, Hanging Rock, W. Va.	2.62	163.49		1.12					135A	SS	Bit. Mac.
12206	Robt. Riley, Capon Bridge, W. Va.	2.60	162.24		1.44					135B	SS	Bit. Mac.
12207	J. M. Belford, Capon Bridge, W. Va.	2.55	159.12		1.96					135B	SS	Blt. Mac.
12208	S. T. Hiett, Capon Bridge, W. Va.	2.53	157.87		2.40					135B	SS	Blt. Mac.
12209	Wm. Hutchins, Capon Bridge, W. Va.	2.55	159.12		2.08					135B	SS	Blt. Mac.
12210	County R. of W., Capon Bridge, W. Va.	2.57	150.37		1.88					135B	SS	Blt. Mac.
12405	E. G. Emmett, Loom, W. Va.	Grading only								135A		Filler for Blt. Mac. Surf
13671	Local	2.70	168.48		3.6					135B	SS	Base Course
13672	Local	2.60	162.24		6.6					135B	SS	Base Course

C. V.=Cementing value.

Road Material Tests, Berkeley County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
793*	Speck property	2.79	174.10		3.76	18.37	12				LS	Concrete
834*	Felker property	2.70	168.50	0.79	4.20	17.64	15				LS	
835*	Barber property	2.68	167.20		4.0	16.95	14.5				LS	
1114*	H. Rutherford property	2.77	172.80	0.24	4.12	18.39	17			67	LS	
1157*	H. Rutherford property	2.72	169.70	0.3	5.3	16.75	5.0			67	LS	Bit. Mac.
331	Std. L. & S. Co.	2.79	177.79	2.48	17.57	25.5					LS	General use
531	Baker Quarries	2.72	169.73		5.86	16.78	10			115	LS	General use
532	Edw. Swart	2.74	170.66		4.26	16.73	9			115	LS	General use
533	Dr. Hoffman	2.81	175.34		4.82	18.05	10			115	LS	General uso
534	Baker Quarries	2.72	169.42		4.62	16.55	10.5			115	LS	General use
1280	Std. L. & S. Co.	2.71	169.1		2.74					115	LS	Concrete
1368	Std. L. & S. Co.	2.83	176.6							115	LS	Bit. Con.
1372	Std. L. & S. Co.	2.75	171.6		3.78					115	LS	Bit. Con.
1387	Std. L. & S. Co.	2.72	169.7		4.52					115	LS	Bit. Con.
1897	J. Dillon property	2.71	169.1		3.84					3028	LS	Concrete
1915	J. Porterfield	2.75	171.6		3.10					3028	LS	Concrete
2567	Baker Quarry	**2.76**	**172.2**		**5.00**					115		Concrete
2577	Baker Quarry	2.85	178.1		3.56	(See card)				115		Concrete
3113	Dan Forsyth, Williamsport, Md.	2.81	175.31		3.48					W'msport Pk.	LS	W. B. Mac.
3114	Jones Stone & Lime, Falling Waters	2.74	170.98		4.40					W'msport Pk.	LS	W. B. Mac.
3142	Blair Limestone, Martinsburg	2.70	168.00		4.84						LS	
3143	Blair Limestone, Martinsburg	2.795	174.00		3.94						LS	
3144	Blair Limestone Co., Martinsburg	**2.725**	**170.00**		**3.94**						LS	
3145	Blair Limestone Co., Martinsburg	2.720	169.80		5.00						LS	
3395	Kearneysville	2.70	168.48		3.44					3221	LS	
3548	I. D. Van Meter	2.67	166.6		3.42					3221	LS	Bridges & Roads
4029	Bri. 785	2.77	172.84			Soundness O. K.—See card for				115 &		Mac. Rd.
						analysis				Br. 785 Crushed	LS	Bridge Work
5415	B. S. Speck	2.635	164.43	0.8	2.16					3028	SS	Base Course
5689	Security Lime & Cem. Co., Security, Md.	2.80	174.72		3.20	See Report for Mech. Anal.				3028		Top Course W. B. Mac.
5690	Security Lime & Cem. Co., Security, Md.	2.87	179.09			See Report for Mech. Anal.				3028		Top Course Mac. W. B.
7295	W. Fuss, Hedgesville, W. Va.	2.775	173.17		1.80					3220	LS	Conc. & Baso

*Old Series Nos.

Road Material Tests, Berkeley County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
7296	L. D. VanMetre, Kearneysville, W. Va.	2.74	170.98		3.90					3221	LS	Conc. & Base
7297	L. M. Files, Johnstown, W. Va.	2.705	168.79		3.80					3220	LS	Conc. & Base
7298	Std. L. & S. Co., Martinsburg, W. Va.	2.695	168.17		5.90					3221	LS	Conc. Base & Top
7349	J. E. Butts, Hedgesville, W. Va.	2.73	170.36		3.80					3220	LS	Base & Top all Conc.
7780	Kearneysville, W. Va.	2.74	170.98		3.70	(Chem. Analysis)				3221	LS	Base Course
8050	Martinsburg, W. Va.	2.70	168.48		4.90	(Chem. Analysis)				3221	LS	Concrete
9350	Martinsburg, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9351	Martinsburg, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9352	Martinsburg, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9353	Martinsburg, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9354	Kearneysville, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9355	Kearneysville, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9356	Martinsburg, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9357	Martinsburg, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9358	Kearneysville, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9359	Kearneysville, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9360	Martinsburg, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9361	Martinsburg, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9362	Kearneysville, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9363	Martinsburg, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9364	Martinsburg, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9365	Martinsburg, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9366	Martinsburg, W. Va. (Barbour Co.)						(Mech. Anal.)			3184	LS	Pen. Mac.
9513	Martinsburg, W. Va. (Barbour Co.)	2.74	170.98				(Mech. Anal.)			3221	LS	All Class Conc.
10790	C. W. Barns, Johnstown, W. Va.	2.73	170.36		O.K.	Calcium Carbonate 96%				3220	LS	A. B. & C. Conc.
11179	Std. L. & S. Co., Martinsburg (Barbour)	2.71	169.11		O.K.					3277	LS	Bit. Mac. Pen.
11180	Std. L. & S. Co., Martinsburg (Barbour)	2.72	169.73		O.K.					3276	LS	Bit. Mac. Intermed.
11278	Std. L. & S. Co., Martinsburg (Barbour)	Grading only								3276	LS	C. Stone Bit. Mac.
11279	Std. L. & S. Co., Martinsburg (Barbour)	Grading only								3276	LS	Inter. C. Stone Bit. Mac.
11280	Std. L. & S. Co., Martinsburg (Barbour)	Grading only								3276	LS	Chips Bit. Mac.

Road Material Tests, Berkeley County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Typo of Construction
11281	Std. L. & S. Co., Martinsburg (Barbour)....	Grading only								3276	LS	Coarse St. Bit. Mac.
11282	Std. L. & S. Co., Martinsburg (Barbour)....	Grading only								3276	LS	Coarse St. Bit. Mac.
11283	Std. L. & S. Co., Martinsburg (Barbour)....	Grading only								3276	LS	Coarse St. Bit. Mac.
11358	Std. L. & S. Co., Martinsburg (Barbour)....				O.K.					3276	LS	Bit. Mac.
11359	Std. L. & S. Co., Martinsburg (Barbour)....				O.K.					3276	LS	Bit. Mac.
11360	Std. L. & S. Co., Martinsburg (Barbour)....				O.K.					3276	LS	Bit. Mac.
11369	Std. L. & S. Co., Martinsburg (Barbour)....				O.K.					County	LS	Bit. Mac.
11370	Std. L. & S. Co., Martinsburg				O.K.					County	LS	Bit. Mac.
11371	Std. L. & S. Co., Martinsburg				O.K.					County	LS	Bit. Mac.
11372	Std. L. & S. Co., Martinsburg (Barbour)....				O.K.					3276	LS	Bit. Mac.
11373	Std. L. & S. Co., Martinsburg (Barbour)....				O.K.					3276	LS	Bit. Mac.
11374	Std. L. & S. Co., Martinsburg (Barbour)....				O.K.					County	LS	Bit. Mac.
11375	Std .L. & S. Co., Martinsburg (Barbour)....				O.K.					County	LS	Bit. Mac.
11376	Std. L. & S. Co., Martinsburg (Barbour)....				O.K.					County	LS	Bit. Mac.
11460	Std. L. & S. Co., Martinsburg (Barbour)....	2.72	169.73		O.K.					3276	LS	Bit. Mac.
11507	Std. L.&S.Co., Martinsburg (Baito.) (Bar.)	Grading only								3276	LS	Bit. Mac.
11508	Std. L.&S.Co., Martinsburg (Baito.) (Bar).	Grading only								3276	LS	Bit. Mac.
11509	Std. L.&S.Co., Martinsburg (Balto.) (Bar.)	Grading only								3276	LS	Bit. Mac.
11510	Std. L.&S.Co., Martinsburg (Baito.) (Bar.)	Grading only								3276	LS	Bit. Mac.
11605	Sta. 326-50	Shale								3220	Shale	Binder Base Course
11606	Sta. 292-50	Shalo								3220	Shale	Binder Base Course
11607	Sta. 315-50	Shaie								3220	Shale	Binder Baso Course
11655	Std. L. & S. Co., Martinsburg (Barbour)....	2.70	168.48		O.K.					3276	LS	Bit. Mac.
11680	Std. L. & S .Co., Martinsburg (Barbour)....	2.71	169.11		O.K.					3276	LS	Bit. Mac.
12404	Std. L. & S. Co., Martinsburg (Barbour)....	Grading only								3325	LS	Bit. Mac. Inter.
12552	Std. L. & S. Co., Martinsburg (Barbour)....	Grading only								3325	LS	Bit. Mac.
12553	Pitt Des Moines S. Co., Martinsburg, W.Va.	Grading only								957 & 3221	LS	Conc. Brl. Floor
12746	Sta. 54 R. of W.	2.67	166.61		1.4	($CaCO_3$	27.6	SiO_2 65.5)		3220 Calcareous	SS	General uso
13234	G. W. Fuss—S. 55, Near Hedgesvillo	2.64	164.74		1.8					3220	SS	Knapped Course
13235	Near Hedgesville, Sta. 60	**2.66**	**165.99**		**1.8**					3220	SS	Knapped Course

Road Material Tests, Morgan County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity.	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
436*	....	2.604	162.41	0.54	2.16	19.47	10.5				SS	
694*	Camp Hill	2.68	167.15	0.87	3.18	18.61	20.5				SS	Concrete
906*	Dawson property	2.70	168.50	0.42	1.46							Bridges
1021*	Dawson property											Bridges
1136*	Cacapon Mtn.					See card						
251	....					Records lost						
374	Pitts. St. Sand Co.	2.58	161.09	1.32	19.55	15.5				3027	SS	Concrete
1026	Proj. 107, Sta. 142	2.67	166.6	0.02	2.66		16.0			107	SS	Concrete
1026	Pro. 107, Sta. 36	2.64	164.4	0.20	1.96					107	SS	Concrete
1197	Standard L. & S. Co.	2.73	170.4		5.64					3034	LS	Concrete
1924	E. Van Renssiller	2.64	164.7	0.68	1.76					3030	SS	Concrete
1925	Harbison Walker	2.65	165.4	0.30	1.90					3030	SS	General use
1926	E. Noland property	2.63	164.1	0.96	2.20					3030	SS	General use
1931	E. Van Renssaler	2.27	141.6	3.1	43.30					3030	SS	General use
3287	Berkeley Springs	2.495	155.68		2.70					3030	SS	Sub. Base
3292	Berkeley Springs	2.600	162.24		2.32					3198	SS	ABC Conc.
3501	John Youngblood	2.63	164.12	1.0	2.22	Soundness O. K.				107	SS	Concrete
3502	John Youngblood	2.58	161.00	1.10	3.08	Soundness O. K.				107	SS	Concrete
7216	Berkeley Springs Sd., Berkeley Spgs., W. Va.	2.54	158.50	1.3	2.20					3030	SS	Br. St. Base Course
7217	Berkeley Springs Sd., Berkeley Spgs., W. Va.	2.59	161.62	1.5	2.20					3030	SS	Base W. B. (ABC)
7258	J. W. Kesecker, Sleepy Creek	2.58	161.00	3.1	5.30					3030	SS	W. B. Mac.
7259	J. W. Kesecker, Sleepy Creek	2.63	164.12	1.2	3.20					3030	SS	W. B. Mac.
7299	E. Van Renseller, Berkeley Springs	2.74	170.98		6.40					3030	LS	O. B. Surf. Base & Sub Base
7300	B. Spgs. L. & S. Co., Berkeley Springs	2.71	169.11		4.82					3030	LS	Conc. Base
7655	Project 3030	2.655	165.67		2.36					3030		Bit. Mac.
7656	Millard S. G. Co.	2.65	165.36		1.44					3030		Bit. Mac.
8352	Berkeley Springs	2.66	165.99							3030A	SS	Cul. & Headw.
9894	....				Mech. Anal.					3030A	SS	Base & Top
9895	Berkeley Springs	2.52	157.25		5.56					3030A	SS	Base & Top
9900	Berkeley Springs	2.445	152.56		16.00					3030A	SS	Knap Base
10173	Berkeley Springs	2.56	159.74		3.72					3030A	SS	Base
11103	Morgan Co. Prod. Co., Berkeley Springs	2.67	166.61		Too small sample ($CaCO_3$ 80.6%)					General	LS	Aggregate
11522	P. L. Kesecker	2.55	159.12		2.34					3030B	SS	Oil bound Mac.
12037	Local	2.61	162.87		1.94					3030C	SS	Base & Top Course Oil Mac.
12604	Project 3030				Mech. Analysis only					3030		Mechanical Anal.
13519	(L. Hamp) Jerry Patterson, Paw Paw, W. Va.	2.65	165.36		3.7					3223 & 3343	SS	A. & B. Conc.
13520	P. L. Kesecker, Berkeley Springs, W. Va.	2.66	165.99		6.4					3030B	SS	Base Course

*Old Series Nos.

Road Material Tests, Jefferson County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
321	Millville	2.85	177.52		3.78	17.30	16				LS	General use
384	Kearneysville	2.65	165.36		3.7	17.51	7				LS	General use
1602	M. Boughter	2.70	168.8		6.12							General use
1603	H. & W. Moore	2.75	171.6		6.28							General use
1604	A. Miller	2.71	169.1		7.02							General use
1605	J. J. McGary	2.70	168.5		2.96							General use
1606	C. F. Walls	2.78	175.8		2.68							General use
1877						See chemical analysis						
3059	R. H. Higginbottom	2.75	171.6		4.90					3218	LS	Macadam
3060	M. Lippett property	2.78	143.5		5.08					3218	LS	Macadam
3061	J. S. Briscoe	2.82	176.3		3.10					3218	LS	Macadam
3062	J. S. Briscoe	2.73	170.4		2.98					3218	LS	Macadam
3070	J. Bell, Rippon, W. Va.	2.75	171.60		4.16					3218	LS	Class A. Mac.
3072	Kearneysville, W. Va.	2.735	170.66		6.00					3026B	LS	General use
3073	Kearneysville, W. Va.	2.74	170.97		5.18					3026B	LS	General use
3074	Kearneysville, W. Va.	2.71	169.10		3.78					3026B	LS	General use
3321	Charles Town, W. Va.	2.76	172.22		2.80					3026	LS	Sub. Base W. Mac.
3322	Charles Town, W. Va.	2.715	169.42		3.20					3026	LS	Sub. Base W. Mac.
3571	Charles Town, W. Va.	2.73	170.36		4.26	Soundness O. K.				3026	LS	Mac. Road
3928	Ransom, W. Va.	2.74	170.98		2.06	Soundness O. K. $CaCO_3$—68%				3026	LS	BC-W. B. Mac.
3940	Std. L. & S. Co.	2.75	171.60		4.10	Soundness O. K. See card for analysis				3026	Dolomite	Top Course, W. B. Mac.
5008	J. H. Briscoe	2.785	173.79		4.56	Soundness O. K.				3218	LS	Base Course
7126	Mrs. Stewart, Kearneysville	2.69	167.86	None	4.68	Soundness O.K. $CaCO_3$—82.1%				3026	LS	Base & Sub. Base
7301	Std. L. & S. Co., Kearneysville	2.735	170.67		3.80					3026B	LS	Conc. Base
7334	Sta. 1 plus 20	2.73	170.36		3.78					3217	CSS-SLS	Pave
7426	Kearneysville, W. Va.	2.72	169.73		3,88	(Chem. Anal.)				3026	LS	Base
7555	J. E. Allen	2.74	170.98		1.68	(Chem. Anal.)				3218	LS	
7556	J. Marlowe	2.720	169.73		2.04	(Chem. Anal.)				3218	LS	
7557	Sta. 150-00	2.725	170.05		2.92	(Chem. Anal.)				3218	LS	
7659	Std. L. & S. Co.	2.73	170.36			Mech. & Chem. Anal.				3217A	LS	Concrete
7708	J. Marlowe	2.74	170.98		2.52	Chem. Anal.				3218	LS	
7751	Kearneysville, W. Va.	2.73	170.36			Chem. Anal.				3278A	CR. LS	A. & B. Conc. Rd. Way
7771	Kearneysville, W. Va.	2.70	168.48		4.44	Chem. Anal.				3026B	LS	Base Course
7772	Rippon, W. Va.	2.695	167.86		4.44	Mech. & Chem. Anal.				3218	LS	A.B.C. Conc. for Bri., Cul & Headw.
8216	Rippon, W. Va.	2.71	169.11			Chem. Anal.				3218	SS ?	Surf. & A. & B.
8218	Rippon, W. Va.	2.72	169.73		2.78	Chem. Anal.				3218	SS ?	Surf. & A. & B.
8580	Rippon, W. Va.	2.735	170.67		3.80	Chem. Anal.				3218	LS	General

Road Material Tests, Pocahontas County, by Testing Department, State Road Commission.

Serial No.	Source	Specific Gravity	Weight per Cu. Ft.	Absorption Lbs. per Cu. Ft.	Abrasion, % Wear	Hardness Coefficient	Toughness Height blow, cms.	Cement Value No. blows	Compression Lbs. per Sq. In.	Project No.	Kind of Rock	Type of Construction
*923	Barlow property	2.36	147.60	5.10	6.06					79	Chert	Bridges
*925	Poogle property	2.73	170.70		4.42	17.59	10			79	SS	Bit. Mac.
3243	Millpoint, W. Va.	2.555	159.43	2.20	4.12				11,375	3051	SS	A. & B. Conc.
3308	Frost, W. Va.	2.40	150.07		(See card for analysis)					3182B	Chert	A. & B. Conc.
3369	Frost, W. Va.	2.71	169.11		5.08					3182B	LS	A. & B. Conc.
3370	Huntersville, W. Va.	1.88	117.31		(See card for analysis)					3182A	Chert	A. & B. Conc.
3379	Marlinton, W. Va.	2.45	152.87	3.10	4.98					3171	SS	A. & B. Conc.
3426	Huntersville, W. Va.	2.56	159.74	1.92	1.74					3050	SS	Concrete
3478	Sta. 555	2.435	151.90	1.92	5.80					3182B	Chert	Concrete
3692	Pocahontas Co.	2.31	144.14	5.1	7.62	(Soundness O. K.—See card for analysis)				3182B	Chert	
7398	Durbin, W. Va.	2.615	163.18	1.2	3.04						SS	Headwalls & Cul.
7775		2.73	170.36		2.80	(Chem. Anal.)				3090	Sil. LS	A. & B. Conc.
7776		2.73	170.36		3.30	(Chem. Anal.)				132	LS	Base & Top Pen. Mac.
7888	Marlinton, W. Va.	2.72	169.73		3.08	(Chem. Anal.)				131	LS	Bit. Mac.
7889	Marlinton, W. Va.	2.65	165.67		4.88					131	SS	Base for Bit. Mac.
8405	Marlinton, W. Va.	2.555	159.43		3.50					131	SS	Base
9451	Mill Point, W. Va.	2.64	164.74		4.74					132		Base B. M.
9494	Mill Point, W. Va.					Mech. Anal.				132	LS	B. M. Surf.
10750	A. I. McNeal, Millpoint, W. Va.	2.545	158.81		4.60					132	SS	Base Course
10751	I. Waugh, Marlinton, W. Va.	2.52	157.25		6.98					131	SS	Base Course
10752	I. Waugh, Marlinton ,W. Va.	2.55	159.12		4.20					131	SS	Base Course
10753	I. Waugh, Marlinton, W. Va.	2.53	157.87		4.90					131	SS	Base Course
12136	Local	2.56	159.74		2.30					General	SS	General
12776	H. Dille, Elk River, W. Va.	2.50	156.00		3.8					149A	SS	Concrete A. & B.

*Old Series Nos.

ROAD MATERIAL ANALYSES.

Through the courtesy of Fred A. Davis and R. B. Dayton of the Testing Department of the State Road Commission, Morgantown, West Virginia, the Survey is able to publish the following results of mechanical and chemical analyses of road material made in the laboratory of the Commission at Morgantown. In the preceding table of road material tests, covering 15 pages, frequent references are made to chemical analyses and mechanical analyses. The following analyses, arranged in serial order, instead of by counties, cover such of these tests as are available. The letter "A" appears to have been added to the original serial numbers as given in the table of tests:

1800A.—Morgan County. Shaly sandstone. Sept. 7, 1922.

	Per cent.
Silica	71.87
Iron oxide	8.63
Alumina	11.10
Calcium carbonate	trace

Soundness O. K.

2307A.—Jefferson County. Dolomite. Project 3034. Oct. 20, 1923. From Standard Lime & Stone Co., Martinsburg, W. Va.

	Per cent.
Silica	4.33
Alumina	3.26
Calcium carbonate	53.00
Magnesium carbonate	36.05

2574A.—Hampshire County. Rock. Nov. 8, 1922.
Calcium carbonate ---------- 16.5 per cent.

2575A.—Hampshire County. Limestone. Tag No. 1.

	Per cent.
Silica	7.57
Calcium carbonate	70.60
Iron oxide and alumina	6.25
Magnesium carbonate	10.22

2854A.—Mineral County. Rock. No. 1. Dec. 6, 1922.
Calcium carbonate ---------- 60 per cent

2855A.—Mineral County. Limestone. No. 2. Dec. 6, 1922.
Calcium carbonate ---------- 57.0 per cent.

3142A.—Berkeley County. Limestone. Quarry No. 1. Feb. 20, 1923.
Calcium carbonate ---------- 96.5 per cent

3143A.—Berkeley County. Dolomitic Limestone. Quarry No. 5. Feb. 20, 1923.
Calcium carbonate ---------- 74.5 per cent.
Magnesium carbonate ---------- 22.8 per cent.

3144A.—Berkeley County. Limestone. Quarry No. 6. Feb. 20, 1923.
Calcium carbonate ---------- 95.0 per cent.

3145A.—Berkeley County. Limestone. Quarry No. 6. Feb. 20, 1923.
Light—Calcium carbonate ---------- 97.8 per cent.
Dark—Calcium carbonate ---------- 97.2 per cent.

3461A.—Pendleton County. Limestone. April 25, 1923. Project 876.

	Per cent.
Silica	47.96
Aluminum oxide and iron oxide	2.50
Calcium carbonate	47.50

3478A.—Pocahontas County. Sta. 555. Chert.

	Weathered. A. Per cent.	Weathered. B. Per cent.	Weathered. C. Per cent.	Solid. D. Per cent.
Silica	90.72	92.10	92.32	76.10
Iron oxide	0.48	0.48	0.48	0.48
Alumina	4.82	4.18	4.12	11.82
Calcium oxide	0.39	0.39	0.39	0.39
Magnesium carbonate	0.37	0.37	0.45	0.56
Volatile	1.74	1.30	1.38	7.66

3659A.—Standard Lime & Stone Co., Keyser, W. Va. General. Limestone. May 12, 1923.

	Per cent.
Carbonate carbonate	79.5
Silica	12.2
Alumina	2.9
Magnesium carbonate	3.8

3938A.—Jefferson County. Limestone. Project 3026. June 4, 1923.
Calcium carbonate ------------------ 68.0 per cent.

3978A.—Hampshire County. Calcareous sandstone. June 7, 1923. Project 3011.

	Per cent.
Silica	59.8
Alumina and iron oxide	13.7
Calcium carbonate	25.2

3979A.—Hampshire County. Calcareous sandstone. No. 3. June 7, 1923. Project 3011.

	Per cent.
Silica	80.20
Alumina and iron oxide	1.50
Calcium carbonate	17.40

4102A.—Mineral County. Limestone. Tag. June 15, 1923. Project 3010.
Calcium carbonate ------------------ 93.6 per cent.

4323A.—Pendleton County. Limestone. June 28, 1923. Project 3175.
Calcium carbonate ------------------ 83.0 per cent.

4514A.—Hampshire County. Calcareous sandstone. July 7, 1923. Project 3011. Marked No. 3.
Calcium carbonate ------------------ 30.8 per cent.

4515A.—Hampshire County. Shale. July 9, 1923. Project 3011. Marked No. 2.

	Per cent.
Silica	54.60
Alumina and iron oxide	30.34
Calcium carbonate	6.25

4515A.—Hampshire County. Calcareous sandstone. July 9, 1923. Project 3011. Marked No. 1.
Calcium carbonate ------------------ 38.6 per cent.

4637A and 4638A.—Pendleton County. Chert. Project 3175A. July 13, 1923.

	Per cent.
Volatile	3.66
Alumina and iron oxide	3.66
Calcium carbonate	1.27
Magnesium carbonate	0.70
Silica	90.01

4639A.—Hampshire County. Sandstone. July 13, 1923. Project 3147A.

	Per cent.
Volatile	1.42
Silica	85.12
Alumina and iron oxide	10.54

4841A.—Hardy County. Sandstone. July 23, 1923. Project 3013.
Silica ---------- 95.2 per cent.

5008A.—Jefferson County. Limestone. Aug. 2, 1923. Project 3218.
Calcium carbonate ---------- 90.0 per cent.

5056A.—Hampshire County. Flint. Aug. 4, 1923. Project 3011B.
Calcium carbonate ---------- 5.3 per cent.

5122A.—Mineral County. Limestone. Aug. 8, 1923. Project 122A.
Calcium carbonate ---------- 89.0 per cent.

5203A.—Pendleton County. Calcareous sandstone. Aug. 14, 1923. Project 3014.
Calcium carbonate ---------- 18.7 per cent.

5282A.—Pendleton County. Limestone. Aug. 20, 1923. Project 3142A.
Calcium carbonate ---------- 94.0 per cent.

5430A.—Pendleton County. Rock. Aug. 31, 1923. Project 3014.
Calcium carbonate ---------- 30.8 per cent.

5689A.—Berkeley County. Rock. Sept. 18, 1923. Project 3028. Dolomite.

6277A.—Mineral County. Rock. Oct. 22, 1923. Project 3010-735.
Calcium carbonate ---------- 91.7 per cent.

7126A.—Jefferson County. Limestone. Jan. 4, 1924. Project 3026.
Calcium carbonate ---------- 82.1 per cent.

7280A.—Hampshire County. Dolomitic Limestone. Jan. 28, 1924. Project 135.
Calcium carbonate ---------- 69.3 per cent.
Magnesium carbonate ---------- 14.15 per cent.

7282A.—Hampshire County. Dolomitic Limestone. Jan. 28, 1924. Project. 135. Marked No. 10.
Calcium carbonate ---------- 50.0 per cent.
Magnesium carbonate ---------- 24.1 per cent.

7285A.—Hampshire County. Shaly sandstone.
Silica ---------- 68.66 per cent.
Alumina ---------- 15.00 per cent.
Soundness test—satisfactory.

7295A.—Berkeley County. Sandstone.
Calcium carbonate ---------- 3.62 per cent.
This is a very hard rock.

7296A.—Berkeley County. Limestone.
Calcium carbonate ---------- 83.0 per cent.

7297A.—Berkeley County. Limestone.
Calcium carbonate ---------- 91.5 per cent.

7298A.—Berkeley County. Limestone. Project 3221. Marked all classes Portland cement concrete, stone base, stone top course.

	Per cent.
Calcium carbonate	97.40
Silica	0.84
Alumina and iron oxide	0.40
Other material	1.36

Analysis to be sent to Bureau of Public Roads.

7299A.—Morgan County. Limestone.
Calcium carbonate ---------- 84.0 per cent.
Magnesium carbonate ---------- 1.5 per cent.
Soundness O. K.

7300A.—Morgan County. Limestone.
Calcium carbonate ---------- 84.0 per cent.
Magnesium carbonate ---------- 1.0 per cent.

7301A.—Jefferson County. Limestone.
Calcium carbonate ---------- 81.8 per cent.
Magnesium carbonate ---------- 7.0 per cent.

7305A.—Hardy County. Limestone. O. K.
Calcium carbonate ---------- 84.5 per cent.
Magnesium carbonate ---------- 1.9 per cent.

7320A.—Mineral County. Limestone.
Calcium carbonate ---------- 78.0 per cent.
Magnesium carbonate ---------- 2.0 per cent.

7323A.—Mineral County. Calcareous sandstone.
Calcium carbonate ---------- 37.4 per cent.
Magnesium carbonate ---------- 2.0 per cent.

7334A.—Jefferson County. Siliceous Limestone. Project 3217.
Calcium carbonate ---------- 69.30 per cent.
Magnesium carbonate ---------- 4.26 per cent.

7349A.—Berkeley County. Limestone. Project 3220. J. E. Butts, Hedgesville.
Calcium carbonate ---------- 96.0 per cent.

7387A.—Hardy County. Mixture of sandstone and calcareous sandstone. The sandstone portion has been weathered considerably, while the calcareous sandstone portion was very hard.
Calcium carbonate ---------- 41.5 per cent.

7401A.—Pendleton County. Limestone.
Calcium carbonate ---------- 76.2 per cent.

7413A.—Pendleton County. Gravel, Chert and Clay. March 22, 1924. Project 3142A.

	Mixture. Per cent.	Sample of Rock. Per cent.
Silica	80.00	93.56
Alumina and iron oxide	15.86	2.87
Calcium oxide	0.50	1.00
Volatile	3.34	0.80

7414A.—Pendleton County. Gravel, Chert and Clay. March 22, 1924. Project 3142A.

	Mixture. Per cent.	Sample of Rock. Per cent.
Silica	78.6	88.4
Alumina and iron oxide	15.9	8.4
Calcium oxide	0.56	1.1
Volatile	4.46	1.7

7426A.—Jefferson County. Limestone, from F. L. Hawkins. Project 3026.

Calcium carbonate	87.5 per cent.
Magnesium carbonate	Considerable.

7454A.—Pendleton County. Gravel. April 8, 1924. Project 3175A. Cletus Shrader.

	Per cent.
Calcium carbonate	46.50
Silica and silicates	46.40
Alumina and iron oxide	2.96

Seven or eight pieces were taken for analysis. This material is a mixture of chert and limestone. Chert and limestone are generally found in the same piece of rock.

7481A.—Grant County. Calcareous sandstone. H. H. Dewhurst, Petersburg, W. Va. For coarse aggregate in making concrete slabs for bridge. Bri. 831.

	Per cent.
Insoluble silica and silicates	55.3
Calcium carbonate	41.3
Alumina and iron oxide	2.2

This is a very hard and looks like it might be a very durable rock.

7531A.—Hampshire County. Limestone. Summerfield Taylor—430. Project 3011.

Calcium carbonate .... 82.0 per cent.

7532A.—Hampshire County. Limestone. Sample No. 1. Summerfield Taylor. Project 3011.

Calcium carbonate .... 89.8 per cent.

7554A.—Hampshire County. Limestone. J. S. Taylor, Mechanicsburg Gap. Project 3011.

	Per cent.
Calcium carbonate	80.6
Silica	7.4
Alumina and iron oxide	1.3
Magnesium carbonate, about	10.0

Soundness O. K.

7554A2.—Hampshire County. Limestone. J. S. Taylor. Project 3011.

Calcium carbonate .... 89.6 per cent.

7555A.—Jefferson County. Limestone. Project 3218. J. E. Allen, E. Dunn Co., Rippon.

Calcium carbonate .... 81.0 per cent.

7556A.—Jefferson County. Limestone. Edw. Dunn & Co. Project 3218.

Calcium carbonate .... 83.0 per cent.

7557A.—Jefferson County. Limestone. Project 3218. Hawkins (Dunn & Co.)

Calcium carbonate .... 85.6 per cent.

7659A.—Jefferson County. Limestone. Project 3217. Standard Lime & Stone Co., Martinsburg, W. Va.
Calcium carbonate .... 86.5 per cent.

7705A.—Jefferson County. Marl. May 29, 1924. Project 3218. Marked G21.

	Per cent.
Calcium carbonate	94.0
Silica	2.06
Alumina and iron oxide	0.96
Moisture on wet sample	24.6

7706A.—Jefferson County. Marl. May 29, 1924. Project 3218. G22.

	Per cent.
Calcium carbonate	91.5
Alumina and iron oxide	1.28
Silica	4.14
Moisture on wet sample	21.0

7708A.—Jefferson County. Siliceous Limestone. Project 3218. F. L Hawkins—Edw. Dunn & Co.

	Per cent.
Silica	30.1
Alumina and iron oxide	3.7
Calcium carbonate	51.0
Magnesium carbonate	15.14

7751A.—Jefferson County. Limestone. Project 3217A. Standard Lime and Stone Co., Kearneysville.
Calcium carbonate .... 86.0 per cent.

7771A.—Jefferson County. Limestone. Project 3026B. T. O. Everhart, Kearneysville.
Calcium carbonate .... 87.6 per cent.

7774A.—Hampshire County. Limestone. Project 3011B. 100′ N. of bin.
Calcium carbonate .... 81.8 per cent.

7772A.—Jefferson County. A mixture of limestone rock. Project 3218 J. S. Briscoe. Analysis of mixture.

	Per cent.
Calcium carbonate	56.4
Silica	20.1
Alumina and iron oxide	6.1
Magnesium carbonate	16.9

7776A.—Pocahontas County. Limestone. Project 132. Stickler.
Calcium carbonate .... 93.0 per cent.

7780A.—Jefferson County. Limestone. Van Meter. Kearneysville. Project 3221.
Calcium carbonate .... 80.0 per cent.

7791A.—Jefferson County. Siliceous Limestone. Project 3218. J. E. Allen.

	Per cent.
Calcium carbonate	57.4
Silica	35.2
Alumina and iron oxide	3.6
Magnesium carbonate, about	3.0

7821A.—Jefferson County. Standard Lime & Stone Co., Engle. Pulverized Limestone.

	Per cent.
Silica	1.14
Calcium carbonate	95.60
Alumina and iron oxide	0.16
Magnesium carbonate	1.81

7888A.—Pocahontas County. Limestone.
Calcium carbonate ---------------------- 85.0 per cent.

7889A.—Pocahontas County. Sandstone.

	Per cent.
Silica	73.86
Alumina and iron oxide	21.54
Calcium oxide	1.63
Magnesium oxide	0.71
Volatile	1.70

8162A.—Hampshire County. Limestone. Project 3011B. Summerfield Taylor Project.
Calcium carbonate ---------------------- 83.0 per cent.

8216A.—Jefferson County. Limestone. Project 3218. F. L. Hawkins.
Calcium carbonate ------------------ 73.0 per cent.
Magnesium carbonate ---------------- 6.0 per cent.

8218A.—Jefferson County. Limestone. Project 3218. J. Marlowe.
Calcium carbonate ------------------ 68.6 per cent.
Magnesium carbonate ---------------- 6.0 per cent.

9449A.—Mineral County. (From Martinsburg, Jefferson County). Limestone.
Calcium carbonate ---------------------- 81.0 per cent.

9869A.—Hampshire County. Limestone. October 5, 1924.
Calcium carbonate ---------------------- 78.2 per cent.
Considerable magnesium carbonate present.

Shales.

	Loss on ignition. Per cent.	Silica. Per cent.	Iron oxide. Per cent.	Alumina. Per cent.	Calcium oxide. Per cent.	Magnesium oxide. Per cent.	Remarks.
10451A	3.00	72.20	8.00	14.50	0.61	1.08	Very hard
10451A	3.90	68.02	6.71	18.50	0.32	0.72	Soft
10452A	7.20	56.90	6.72	18.14	5.09	1.79	Very good shale surface.
10453A	6.60	61.26	6.81	22.69	0.36	0.90	
10454A	5.98	55.06	8.32	24.08	0.36	0.72	Good.
10455A	6.10	58.26	8.01	20.28	0.31	2.02	Very good.
10456A	6.81	56.62	9.62	23.14	0.33	1.01	Good results as base course.
10457A	5.30	58.70	8.02	15.41	0.31	4.92	Very good.
10458A	7.41	57.70	5.86	24.81	0.31	0.41	Good but breaks up under long rains.
10459A	4.41	71.41	6.52	12.61	0.31	1.04	
10460A	7.30	65.42	3.52	19.68	0.32	0.72	
10461A	5.30	61.84	6.72	20.08	0.31	1.40	
10462A	4.30	59.30	7.36	21.58	0.62	1.08	Very good.
10463A	7.01	59.32	6.41	16.90	3.72	0.90	Very good.
10464A	3.94	66.78	6.42	16.40	0.56	1.34	Exceptional for base under 3" macadam surface.
10465A	6.91	58.26	6.88	22.12	0.56	0.41	

"It seems that a low silica and iron oxide content and a high alumina, calcium oxide and magnesium oxide content give the best results."

Nos. 10451A to 10457A are from Mineral County, Project 3010. No. 10458A is from Hampshire County, Project 3012. Nos. 10459A to 10461A are from Hardy County, Project 3013. Nos. 10462A to 10464A are from Hampshire County, Project 3012. No. 10465A is from Hardy County, Project 3013.

10790A.—Berkeley County. Rock. May 14, 1925.
Calcium carbonate .... 96.0 per cent.

10915A.—Hampshire County. Limestone.
Calcium carbonate .... 62.7 per cent.

11103A.—Morgan County. Limestone. June 5, 1925.
Calcium carbonate .... 80.6 per cent.
Soundness test is O. K.

11147A.—Hampshire County. Rock. June 5, 1925.
Calcium carbonate .... 65.0 per cent.
Contains considerable magnesium carbonate.

11285A.—Mineral County. Shale. June 18, 1925.

	Per cent.
Loss on ignition	11.80
Silica	58.66
Alumina	16.94
Iron oxide	9.12
Calcium oxide	0.17
Magnesium oxide	0.28
	96.97

11285A.—Mineral County. Shaly limestone.

	Per cent.
Silica	26.2
Alumina and iron oxide	13.1
Calcium carbonate	51.5

11421A.—Grant County. Shale. June 29, 1925.

	Per cent.
Loss on ignition	8.66
Silica	57.00
Iron oxide	9.12
Alumina	20.42
Calcium oxide	0.56
Magnesium oxide	1.45
	97.21

Soundness not entirely satisfactory.

11442A.—Hardy County. Shale. Right of Way, Project 3214A. Sta. 50+00. H. C. Lassing, Jr., Moorefield, W. Va. June 18, 1925.

	Per cent.
Loss on ignition	5.50
Silica	60.96
Iron oxide	8.64
Alumina	18.34
Calcium oxide	1.29
Magnesium oxide	1.18
	95.91

Sodium and potassium oxides compose the principal part of the remainder.
Soundness not satisfactory.

11605A, 11606A, and 11607A.—Berkeley County. Shales. July 16, 1925.

	11605A Per cent.	11606A Per cent.	11607A Per cent.
Loss on ignition	5.1	5.9	5.3
Silica	60.8	61.6	61.6
Alumina	20.6	19.5	20.5
Iron oxide	7.7	7.5	7.7
Calcium oxide (estimated)	0.3	0.3	0.3
Magnesium oxide (estimated)	0.4	0.4	0.4
Potassium and sodium oxides	Not run.	Not run.	Not run.

11624A.—Grant County. Shale. Project 107. Sta. 150. John Lee Gravel Co.

	Per cent.
Loss on ignition	13.1
Silica	52.3
Alumina	24.8
Iron oxide	6.4
Calcium oxide	1.1
Magnesium oxide (estimated)	0.5

Soundness very bad.

11827A.—Hampshire County. Limestone. July 22, 1925.
Calcium carbonate 81.4 per cent.

11829A.—Hampshire County. Limestone. July 22, 1925.
Calcium carbonate 61.5 per cent.
Contains considerable magnesium carbonate.

11996A.—Mineral County. Sandstone. August 7, 1925.
Soundness O. K.

12313A.—Grant County. Shale.

	Per cent.
Loss on ignition	3.7
Silica	62.2
Alumina	18.3
Iron oxide	8.0
	92.2
Moisture	2.0

Soundness very unsatisfactory.

12604A.—Morgan County. Rock. No. 1. September 14/19, 1925. Submitted by R. B. Dayton, Morgantown, W. Va.

	Per cent.
Loss on ignition	1.70
Silica	83.34
Alumina	8.70
Iron oxide	4.10
	97.84

12605A.—Grant County. Shale. No. 2. September 14/19, 1925. Submitted by R. B. Dayton, Morgantown, W. Va.

	Per cent.
Loss on ignition	5.60
Silica	56.68
Alumina.	22.66
Iron oxide	8.50
Other material	6.56

12746A.—Berkeley County. Calcareous sandstone. Sept. 23, 1925.

	Per cent.
Silica	65.54
Alumina and iron oxide	3.70
Calcium carbonate	27.60

A very hard rock.

13235A.—Berkeley County. Sandstone.

	Per cent.
Silica	90.6
Alumina and iron oxide	6.0
Calcium carbonate	3.4

This is an exceptionally hard rock.

13519A.—Morgan and Hampshire Counties. Sandstone. November 20, 1925.
Soundness O. K.

13520A.—Morgan County. Sandstone. November 20, 1925.
Soundness O. K.

13671A and 13672A.—Hampshire County. Sandstone. Dec. 9, 1925.
Soundness O. K.

Some additional tests of shales, etc., bearing higher serial numbers than those tabulated in the preceding tables of road material tests, are given below:

13993A.—Pendleton County. Shale. Project 3208A. March 3, 1926.

	Per cent.
Oven loss (@ 100° C.)	1.1
Loss on ignition	6.0
Silica	59.8
Iron oxide	7.1
Alumina	22.2
Calcium oxide	trace
Magnesium oxide	0.9

13994A.—Pendleton County. Shale. Project 3208A. March 2/3, 1926.

	Per cent.
Oven loss (@ 100° C.)	1.1
Loss on ignition	5.7
Silica	64.0
Iron oxide	5.8
Alumina	19.1
Calcium oxide	trace
Magnesium oxide	1.2

13995A.—Pendleton County. Sandstone. Project 3208A.

	Per cent.
Silica	71.80
Iron oxide	14.15
Alumina	10.00

A sandstone with a high percentage of iron and aluminum oxides.

14043A.—Pendleton County. Shale. Project 3213A. Sh. 1. Right of Way. Quantity represented, 1000 cu. yards. Submitted by W. T. Tibbets, Franklin, W. Va. Sample February 20, 1926, right of Sta. 176+00. March 2, 1926.

	Per cent.
Silica	60.00
Iron oxide	6.59
Alumina	21.13
Calcium oxide	1.18
Magnesium oxide	1.30
Loss on ignition	6.16
	96.36

14044A.—Pendleton County. Shale. Project 3213A. Sh. 2. Right of Way. Quantity represented, 2000 cu. yds. Submitted by W. T. Tibbets, Franklin, W. Va. Sampled February 20, 1926, right of Sta. 189+00. March 2, 1926.

	Per cent.
Silica	57.58
Iron oxide	7.56
Alumina	20.98
Calcium oxide	0.68
Magnesium oxide	1.14
Loss on ignition	6.25
	94.19

14045A.—Pendleton County. Shale. Project 3213A. Sh. 3. Right of Way. Quantity represented, 500 cu. yds. Submitted by W. T. Tibbets, Franklin, W. Va. Sampled February 20, 1926, right of Sta. 126+00. March 2, 1926.

	Per cent.
Silica	56.86
Iron oxide	8.20
Alumina	22.76
Calcium oxide	0.73
Magnesium oxide	1.48
Loss on ignition	6.07
	96.10

14046A.—Pendleton County. Shale. Project 3213A. Sh. 4. Right of Way. Quantity represented, 1500 cu. yds. Submitted by W. T. Tibbetts, Franklin, W. Va. Sampled February 20, 1926, right of Sta. 109+00. March 2, 1926.

	Per cent
Silica	54.20
Iron oxide	6.75
Alumina	23.47
Calcium oxide	2.70
Magnesium oxide	1.02
Loss on ignition	8.35
	96.49

14047A.—Pendleton County. Shale. Project 3213A. Sh. 5. Right of Way. Quantity represented, 3000 cu. yds. Submitted by W. T. Tibbets, Franklin, W. Va. Sampled February 20, 1926, right of Sta. 83+00. March 2, 1926.

	Per cent.
Silica	58.40
Iron oxide	6.59
Alumina	19.51
Calcium oxide	1.13
Magnesium oxide	1.30
Loss on ignition	7.79
	94.72

17994A, 17995A, 17996A, 17997A, and 17998A.—Hardy County. Shale. These five samples of shale from Hardy County were submitted by K. R. Palmer, Moorefield, W. Va., Oct. 1, 1926. All from Project 3214B. 17994A from Sta. 394+25; 17995A from Sta. 347+00; 17996A from Sta. 369+00; 17997A from Sta. 450+00; and 17998A from Sta. 307+00.

	17994A. Per cent.	17995A. Per cent.	17996A. Per cent.	17997A. Per cent.	17998A. Per cent.
Oven loss (@ 100° C.)	1.33	1.44	1.19	1.34	0.67
Loss on ignition	4.71	4.60	4.36	4.46	4.43
Silica	65.41	63.45	62.80	61.17	66.16
Iron oxide	3.68	4.72	5.38	5.71	6.37
Alumina	20.38	21.15	21.34	21.86	18.31
Calcium oxide	trace	trace	trace	trace	trace
Magnesium oxide	0.73	0.79	1.22	0.62	1.00
Totals	96.24	95.15	96.29	95.16	97.54

17999A, 18000A, 18001A, 18002A, and 18003A.—Hardy County. Shale. These five samples of shale from Hardy County were submitted by K. R. Palmer, Moorefield, W. Va., Oct. 1. 1926. All from Project 3214B. 17999A from Sta. 561+00; 18000A from Sta. 278+25; 18001A from Sta. 499+00; 18002A from Sta. 293+00; and 18003A from Sta. 410+00.

	17999A. Per cent.	18000A. Per cent.	18001A. Per cent.	18002A. Per cent.	18003A. Per cent.
Oven loss (@ 100° C.)	0.60	0.72	0.41	0.89	0.67
Loss on ignition	3.25	3.05	2.30	3.63	3.38
Silica	72.26	69.48	79.65	71.10	72.83
Iron oxide	5.96	7.56	4.96	6.05	6.72
Alumina	14.76	15.65	10.99	14.94	14.34
Calcium oxide	trace	trace	trace	trace	trace
Magnesium oxide	0.71	0.85	0.40	1.36	0.37
Totals	97.54	97.31	98.71	97.97	98.31

18384A and 18385A.—Pendleton County. Shale. These two samples of shale were submitted by A. D. McReynolds, Franklin, W. Va., October 13, 1926. Project 3208A. 18384A was from a point 1000 feet left of Sta. 450+25, while 18385A was from Sta. 387 to 391, bank of county road, 1000 feet north of Oak Flat.

	18384A. Per cent.	18385A. Per cent.
Oven loss (@ 100° C.)	0.92	0.74
Loss on ignition	6.48	6.53
Silica	63.33	54.66
Iron oxide	3.92	6.60
Alumina	21.45	22.61
Calcium oxide	trace	2.62
Magnesium oxide	0.66	0.73
Totals	96.76	94.49

19016A.—Hardy County. Shale. Project 3148. Quantity unlimited. Submitted by Seymour Fisher, Moorefield, W. Va., March 15, 1927.

	Per cent.
Loss on ignition	5.18
Silica	55.46
Iron oxide	10.44
Alumina	23.63
Calcium oxide	1.14
Magnesium oxide	0.26
	96.11

19047A.—Jefferson County. Dolomite. Project 1039.

	Per cent.
Loss on ignition	44.55
Silica	4.25
Iron oxide and Alumina	1.37
Calcium oxide	30.11
Magnesium oxide	21.67
	101.95

19347A.—Hardy County. Shale. Project 3214B. Samuel Buck. Quantity represented, 700 cu. yds. Submitted by K. F. Buck, Moorefield, W. Va., April 28, 1927. Pit, Sta. 480. Typical shale.

	Per cent.
Loss on ignition	5.12
Silica	57.15
Iron oxide	10.69
Alumina	20.92
Calcium oxide	trace
Magnesium oxide	0.77
	94.65

19610A, 19611A, 19612A, 19613A, 19614A, and 19615A.—Hardy County. Shale. These 6 samples of shale were submitted by K. F. Buck, Moorefield, W. Va., June 6, 1927, all from Project 3214B. Source of shale: 19610A, Union Lumber Co., Moorefield, W. Va.; 19611A, Union Lumber Co., Moorefield, W. Va.; 19612A, Laura Wise, near Moorefield, W. Va.; 19613A, S. Ketterman, near Moorefield, W. Va.; 19614A, Laura Wise, near Moorefield, W. Va.; and 19615A, Union Lumber Co., Moorefield W. Va. The samples were taken on May 17 and 18, 1927. 19610A from Sta. 317; 19611A from Sta. 325; 19612A from Sta. 428; 19613A from Sta. 407+50; 19614A from Sta. 435; and 19615A from Sta. 336. Quantity represented: 19610A, 800 cu. yds.; 19611A, 800 cu. yds.; 19612A, 1500 cu. yds.; 19613A, 1500 cu. yds.; 19614A, 1000 cu. yds.; and 19615A, 500 cu. yds. Examined for shale surfacing. All were reported typical shale analyses.

	19610A.	19611A.	19612A.	19613A.	19614A.	19615A.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Loss on ignition	2.87	2.28	2.57	3.82	3.02	2.73
Silica	79.17	84.71	78.50	66.40	77.16	81.54
Iron oxide	3.23	2.81	5.53	7.57	4.76	3.66
Alumina	13.43	9.07	11.01	18.01	11.42	10.76
Calcium oxide	0.67	0.71	1.11	0.49	0.53	0.48
Magnesium oxide	trace	trace	trace	trace	trace	trace
Totals	99.37	99.58	98.72	96.29	97.89	99.15

ROAD MATERIAL SURVEYS.

The State Road Commission, under the supervision of the Division of Tests, Morgantown, W. Va., under date of May, 1927, has completed a Materials Survey for Rock on Project No. 3147 (the road from Frenchburg to Augusta on the Northwestern Pike) in Hampshire County. The examination and report were made by Mr. Delmar Runner. This report shows the materials available along or near the right of way for construction purposes. The report also covers a Materials Survey for Project 134 to the east of Project 3147. Through the courtesy of Fred A. Davis and R. B. Dayton of the Division of Tests, Morgantown, the Survey is able to publish Mr. Runner's reports. Sample number refers to the number given to specimen after it is received by the Division of Tests. The figure in parentheses is the identification number given to the specimen by Mr. Runner, while in the field. All quantities are estimated from observation alone and are based upon the different dimensions of the strata exposed. This note applies to both Projects 3147 and 134.

REPORT ON MATERIALS SURVEY.

HAMPSHIRE COUNTY—PROJECT 3147.

Sample 19427 (5).

Kind of Rock: A reddish-brown, fine-grained sandstone.
Location: About 70′ right of station 256+75.
Owner of property: Mr. O. E. Kerns.
Estimated Quantity: 5,000 cubic yards.
Overburden: Amounts to about 2′ at the face and increases to about 5′ and then remains uniform.

Remarks: This sample represents a sandstone ledge on the east bank of Tearcoat Branch. Outcrop begins about 70′ from concrete bridge and extends upstream about 150 feet. Maximum thickness exposed is about 15′ and minimum thickness about 6′. Ledge shows favorable signs of extending downward. vertically, so that a large quantity of material should be obtained at this location. Waste mateial could be thrown on banks of Tearcoat Branch, and water for crusher purposes could be obtained from same stream.

SUMMARY OF MATERIALS SURVEY FOR ROCK
HAMPSHIRE COUNTY—PROJECT 3147

Sample No.	Field Sample	Station No.	Form of Rock	Estimate Cu. Yds.	Distance from Road	Owner	Per Cent. Wear.
19427	5	256+75	Ledge	5000	70′ R.	O. E. Kerns	2.4
19442	6	242+63	Quarry	5000	100′ L.	Mr. Martin	1.8
19459	7	242+00	Ledge	4000	200′ R.	J. S. Richman	1.7
19460	8	220+30	Ledge	3500	R. of W.	J. S. Richman	1.8
19443	9	30+30	Ledge	4000	1500′ R.	J. F. Fry	1.3
19444	10	20+80	Quarry	4000	700′ R.	J. F. Fry	1.4
19445	11	Little Cacapon	Boulders	2000	700′ R.	J. F. Fry	1.2
19461	12	Proj. 72, Sta. 216+00	Quarry	3000	60′ R.	--------------	2.8

SUMMARY OF MATERIALS SURVEY FOR ROCK
HAMPSHIRE COUNTY—PROJECT 134

Sample No.	Field Sample	Station No.	Form of Rock	Estimate Cu. Yds.	Distance from Road	Owner	Per Cent. Wear.
19423	1	475+97	Ledge	6000	R. of W.	J. C. Rogers	1.8
19424	2	465+80	Ledge	Unlimited	R. of W.	J. C. Rogers	1.5
19425	3	477+50	Quarry	4000	1500′ L.	J. C. Rogers	3.0
19426	4	465+80	Ledge	Unlimited	60′ R.	J. C. Rogers	1.8

Sample 19442 (6).

Kind of Rock: A gray fine-grained sandstone.

Location: 100 feet left of station 242+63.

Owner of property: Mr. Martin.

Estimated quantity: 5,000 cubic yards.

Overburden: About 6' to 7' of rock exposed, carrying about 3' to 4' of waste material. The rock is exposed farther upstream so that very little material will have to be removed along this particular place. Quarry will need cleaning out before operations are started.

Remarks: Stone has been removed from this quarry for culverts and headwalls. Although only a few feet of rock is exposed, indications are good that a large quantity of stone could be obtained at this location.

Sample 19459 (7).

Kind of Rock; A reddish-brown, fine-grained sandstone.

Location: About 200' to the right of station 242+00, on south bank of Bearwallow Branch.

Owner: J. S. Richman.

Estimated Quantity: 4,000 cubic yards.

Overburden: Amounts to about 2 feet at the face of ledge and increases gradually.

Remarks: This sample represents a sandstone ledge whose apparent base begins about 15 to 20 feet above stream level. The outcrop has an exposed length of nearly 80 feet and a thickness of about 10 to 12 feet. Outcrop is nearly 200 feet from highway but stone could easily be hauled to road, and one crusher plant at this site could take care of location No. 6 as well. The water-level in Bearwallow Branch should be comparatively low during the summer months so that this item should cause no trouble.

Sample 19460 (8).

Kind of Rock: A brown, medium-grained sandstone.

Location: Right of way, left of station 220+30.

Owner: J. S. Richman.

Estimated Quantity: 3,500 cubic yards.

Overburden: Amounts to about 2 feet at the face of ledge and increases gradually in thickness.

Remarks: This sample was taken from ledge of rock outcropping at road level. The stone is medium-grained and tends to be shaly and laminated, but a good quantity of material could be obtained at this place. The strata dip about 20° S. E. and are exposed along highway for about 50 feet. The west end of outcrop is very shaly and care would have to be exercised in choosing the best quality stone. Waste material could be thrown over bank of highway. Area above outcrop is slightly wooded.

Sample 19443 (9).

Kind of Rock: A gray, fine-grained sandstone.

Location: Up a county road about 1,500 feet from U. S. Route 50. Leave highway at station 30+30.

Owner: Mr. J. F. Fry.

Estimated Quantity: 4,000 cubic yards.

Overburden: Amounts to about 3 to 4 feet and would increase gradually in thickness as the formation was quarried.

Remarks: Outcrop lies adjacent to county road, but at a distance of about 1,500 feet from State highway. The stone dips about 55° to 60° east and may or may not pinch out. The face of ledge seems to be laminated and shaly in appearance, but should be of better quality deeper in the formation. The county road is in fairly good condition and crosses two "fords", both of which are shallow.

Sample 19444 (10).

Kind of Rock: A dark-gray, fine-grained sandstone.

Location: On the south bank of the South Fork of Little Capacon River, and at a distance of about 700′ from the State highway.

Owner: Mr. J. F. Fry.

Estimated Quantity: 4,000 cubic yards.

Overburden: Amounts to about 3 to 5 feet of soil.

Remarks: This sample represents a ledge of sandstone occurring in an unused quarry. The ledge begins about 5 to 7 feet above water-level has an apparent thickness of between 15 and 18 feet. Rock could be hauled across Little Cacapon River and a broad bottom land to the State highway. This stream is low during the summer months, but a corduroy road should be built across the bottom land. The quarry will have to be cleaned out before operations are started.

Sample 19445 (11).

Kind of Rock: Stream boulders, made up chiefly of fine- and medium-grained sandstone.

Location: Stream bed of the South Fork of Little Cacapon River, approximately between stations 20+00 and 30+30.

Owner: Mr. J. F. Fry.

Estimated Quantity: 1,500 cubic yards.

Remarks: This sample represents as nearly as possible the boulders in the bed of the stream mentioned above. A 30-pound sample could not possibly be representative of the entire area covered by such boulders, but it does give a good idea of the quality of the material to be obtained. The stone is almost wholly angular and a good quantity of material should be got out of the stream bed. The stone could be hauled to the highway over the same corduroy road constructed for location No. 10.

Sample 19461 (12).

Kind of Rock: A reddish-brown, fine-grained sadstone.

Location: Project 72, station 216, 2.5 miles from beginning of Project 3147.

Estimated Quantity: 3,000 cubic yards.

Overburden: Minimum at the face of quarry is about 2 feet, and the maximum, about 6 feet, all of which will increase as the ledge is quarried.

Remarks: This sample was taken from a quarry opened along Project 72. The face of quarry is laminated and jointed but should be of better quality deeper into the formation. The strata dip about 20° to 25° west, and part of overburden consists of loose fragmental laminated sandstone. Stone from this quarry could be hauled about 2.5 miles to the beginning of Project 3147. Quarry will have to be cleaned out before operations are begun.

REPORT SHOWING MATERIAL SURVEY FOR ROCK.

HAMPSHIRE COUNTY—PROJECT 134.

The summary of materials survey for Project 134 has been combined with the summary for Project 3147, on a preceding page of this report.

REPORT OF MATERIALS SURVEY
HAMPSHIRE COUNTY—PROJECT 134.

Sample 19423 (1).

Kind of Rock: A light-brown, fine-grained sandstone.

Location: Begins at left of station 475+97 and extends eastward about 75 feet.

Owner of Property: Mr. J. C. Rogers, Hanging Rock.

Estimated Quantity: 6,000 cubic yards.

Overburden: Practically none.

Remarks: The outcrop lies on the left of highway and is adjacent to it. The stone appears to be of the same quality throughout the entire formation. Although the rock is broken up and jointed at the face, it should be more solid and of better quality deeper into the strata. Surface of ledge is slightly wooded. All wastes material could be thrown over side of road or hauled about 400 feet east and dumped on a "fill" at this place. Water for crusher purposes could be obtained from a small stream paralleling U. S. Route 50. A fairly good crusher site is available at this location. The formation appears to dip to the northwest.

Sample 19424 (2).

Kind of Rock: A light-brown, fine-grained sandstone.

Location: Right of way opposite station 465+80.

Owner: Mr. J. C. Rogers, Hanging Rock.

Estimated Quantity: Practically unlimited.

Overburden: None.

Remarks: The rock outcrops at road level and attains a thickness of about 40 to 50 feet. The formation seems to be fairly uniform in hardness and size of grain, etc. The rock is considerably broken up and jointed and there appears to be no uniformity in the direction of dip of the strata. The rusty color of the stone is probably due to the presence of an iron oxide. Water for crusher purposes could be obtained from Hanging Rock Branch, and Mr. Rogers will be glad to dispose of the stone.

Sample 19425 (3).

Kind of Rock: A dark-gray, fine-grained dolomitic limestone.

Location: About 1,500 feet north of road at Hanging Rock, leaving highway at station 477+50.

Owner of Property: Mr. J. C. Rogers, Hanging Rock.

Estimated Quantity: 4,000 cubic yards.

Overburden: Amounts to about 1 to 3 feet.

Remarks: This outcrop of dolomitic limestone is found about 1500 feet from highway. The formation dips about 80° west and carries considerable overburden. Part of the ledge will have to be stripped to uncover the major portion of the limestone ledge. A formation of shaly limestone outcrops at stream level, near the outcrop mentioned above, and with a slight amount of stripping, a considerable amount of stone could be obtained. There is a crushing plant set up at this location and the haul from quarry to highway is practically down grade all the way.

Sample 19426 (4).

Kind of Rock: A light-brown, fine-grained sandstone.

Location: South bank of Hanging Rock Branch, opposite station 465+80.

Owner of Property: Mr. J. C. Rogers, Hanging Rock.

Estimated Quantity: Unlimited.

Overburden: Practically none.

Remarks: This ledge of sandstone occurs on the south bank of Hanging Rock Branch, opposite station 465+80. The outcrop begins at stream level and attains a thickness of between 40 and 50 feet, and an over-all length of about 60 feet. The rock dips east and southeast and is jointed and broken up. This location could be quarried in conjunction with location No. 2, given in a preceding paragraph. One crusher could take care of both locations. Mr. Rogers would be glad to dispose of above-mentioned rock and an almost unlimited amount of stone could be obtained here.

STANDARD SPECIFICATIONS.

PER CENT. OF WEAR FOR SUITABILITY.

At the present time, the State Road Commission in making tests of suitability of limestone, sandstone, etc., for road purposes, has abolished the tests for absorption, hardness coefficient, toughness, compression, etc., and is now basing its recommendations on per cent. of wear (abrasion) alone. Mechanical and chemical analyses, however, are made at times. The maximum allowable per cent. of wear for various road-making purposes is as follows:

		Maximum allowable per cent. of wear.
a	Telford base course	10
b	Knapped stone base course	10
c	Broken stone base course	8
d	Plain cement concrete base course	6
e	1 course cement concrete pavement	6
f	Coarse aggregate, class A, B, C concrete	6
g	Coarse aggregate, Bridges	6
h	Binder course, sheet asphalt	6
i	Bituminous Macadam (Sandstone)	4
j	Bitumnious Macadam (Limestone)	6
k	Modified Bituminous Macadam	5
l	Bituminous Concrete (Limestone)	6
m	Water-bound Macadam, top course (Limestone)	6

As some of the notations in the Table of Tests refer to items no longer tested by the State Road Commission and as possibly some of the terms mentioned in the table above are not entirely clear to many not engaged in road construction work, the following definitions of some of these terms, taken from the April, 1926, Standard Specifications for State Road Construction, issued by the State Road Commission, will be of general interest and value:

DEFINITION OF TERMS.

Class "A" Concrete.—Class "A" Concrete shall be composed of one (1) part of Portland cement, and six (6) parts of fine and coarse aggregates, each measured separately and accurately by volume. This concrete shall approximate a 1:2:4 mix, but the Engineer may vary the relative proportions of fine and coarse aggregate. Class "A" concrete shall be used in all reinforced concrete culverts, reinforced abutments, reinforced wing and web walls, reinforced concrete retaining walls, and in plain curbs, gutters and headers.

Class "B" Concrete.—Class "B" Concrete shall be composed of one (1) part of Portland cement and seven and one-half (7½) parts of fine and coarse aggregates, each measured separately and accurately by volume. This concrete shall approximate a 1:2½:5 mix, but the Engineer may vary the relative proportions of fine and coarse aggregates. Class "B" concrete shall generally be used in all gravity structures, such as abutments, wing walls, culvert headwalls, in reinforced concrete encasement around corrugated metal pipe culverts and concrete foundations for pavements.

Class "C" Concrete.—Class "C" Concrete shall be composed of one (1) part of Portland cement and nine (9) parts of fine and coarse aggregates, each measured separately and accurately by volume. This concrete shall approximate a 1:3:6 mix, but the Engineer may vary the relative proportions of fine and coarse aggregates. Class "C" concrete shall be used in the foundations of all gravity structures, such as abutments, wing walls, retaining walls, and in concrete encasement for vitrified culvert pipe.

Rubble Stone.—Rubble "one-man stone" may be embedded in Class "B" or "C" concrete where shown on the plans or authorized by the Engineer. They shall not be placed within three (3) inches of any finished surface of the concrete and shall be placed at least three (3) inches apart. The stone for this purpose shall consist of clean, sound, rubble stone, free from structural defects, foreign substances and coating of any character, and shall be of a quality satisfactory to the Engineer.

Coursed Stone Masonry.—Stone.—All stone for this work shall be stone of approved quality, sound, free from structural defects, earth, clay or other foreign substance, and from which all weak points and angles have been removed. Selected stones, roughly squared and pitched to line, shall be used at all angles and ends of walls. The stones for the faces of the wall shall not be less than nine (9) inches thick nor less than twelve (12) inches in length; the width shall not be less than the thickness, and the length shall not exceed three (3) times the thickness. Small stones of similar quality may be used for pinning and for the interstices in the heart of the wall.

Mortar.—This mortar shall be composed of one (1) part of Portland cement and three (3) parts of approved fine aggregate. At the option of the Contractor, a combination may be made of ninety (90) per cent. by volume, of Portland cement, and ten (10) per cent. by volume, of approved hydrated lime. The fine aggregate shall consist of clean, hard, durable grains which shall not contain more than five (5) per cent. by weight of loam or other foreign substances. It shall be of such size that all will pass a laboratory screen having one-eighth (⅛) inch circular openings. ****Mortar for pointing shall be mixed in the proportions of one (1) part of cement to one (1) part of fine aggregate.

Riprap.—Riprap shall be composed of approved stone laid on slopes or shoulders to protect them from slipping or washing, at places indicated on the plans or where directed, in accordance with these specifications. **Stone.**—This stone shall be sound "one-man stone", free from structural defects, and of approved quality, not less than one-third (⅓) of a cubic foot in volume, and not less than three (3) inches thick. The width of no stone shall be less than two and one-half (2½) times its thickness, and the depth shall be as shown on the plans.

Broken Stone Base Course.—Broken Stone.—The broken stone for this course shall consist of angular fragments of rock of uniform quality throughout, containing not to exceed 5% thin or elongated pieces, soft or disintegrated stone, dirt or other objectionable matter. It shall have a per cent. of wear of not more than eight (8). This material shall be uniformly graded and of such size that all will pass over a screen having circular openings 1¼ inches in diameter, and through a screen having circular openings four (4) inches in diameter. **Broken Slag.**—The slag for use in this course shall consist of angular fragments, reasonably uniform as to density and quality, free from metallic iron, dirt or other objectionable matter. It shall have a weight per cubic foot, when shaken to refusal, of not less than 70 pounds. The grading shall be as specified for broken stone.

Bank Run Gravel Base Course.—Material.—The gravel shall be composed of hard, durable stone and assorted sizes of finer materials. The amount of material passing a one-quarter (¼) inch screen should not exceed the amount retained thereon. The gravel should be stony and should not contain over fifteen (15) per cent. of loam. Loading from the pits or banks shall be performed in such a manner and by such methods that a uniform grade of material will be delivered upon the road.

Telford Base Course.—Materials.—The materials for this work shall consist of sound, tough, durable stone, free from clay, loam or other foreign substances, having a per cent. of wear of not more than ten (10). The pieces shall be approximately rectangular in section, having a depth equal to the thickness of course, width of from two (2) to six (6) inches and a length of from six (6) to twelve (12) inches. The small tone for filling the voids in the large material shall consist of material at least equal in quality to that of the large stone.

Bituminous Macadam Surface Course.—Broken Stone or Slag.—The stone shall consist of angular broken stone of uniform quality throughout, free from thin or elongated pieces, or soft or disintegrated stone, dirt, dust or other objectionable matter. When tested in the laboratory, the stone shall show a per cent. of wear of not more than six (6) for limestone and not more than four (4) for sandstone. The stone shall show no signs of checking, cracking, or disintegration in the sodium sulphate solution for soundness. The stone shall meet the following graduation requirements:

	Per cent.
Coarse Stone:	
Passing a 3-inch screen	95 to 100
Retained on a 1½-inch screen, not less than	95
Intermediate Stone:	
Passing a 3-inch screen	95 to 100
Passing 1-inch screen	25 to 75
Passing ¾-inch screen, not more than	15
Chips:	
Passing ¾-inch screen	95 to 100
Passing ½-inch screen	60 to 75
Passing ¼-inch screen, not more than	15

The broken slag shall be clean, sound, durable, reasonably uniform in density and free from thin or elongated pieces. Slag shall have a weight per cubic foot, when shaken to refusal, of not less than seventy (70) pounds for each size of slag specified. The slag shall show no signs of checking, cracking or disintegration in the sodium sulphate solution test for soundness. The grading for the slag shall be the same as for broken stone.

Bituminous Material.—Bituminous material of the kind specified on the plans shall be used, and shall be heated to and applied at a temperature of not less than two hundred and twenty-five (225) F., nor more than three hundred and twenty-five (325) F., if an asphalt, and not less than one hundred and seventy-five (175) F., nor more than two hundred and fifty (250) F., if a tar.

Waterbound Macadam Surface Course.—Broken Stone or Slag.—Broken stone or slag shall consist of angular fragments containing not more than 5 per cent. of thin or elongated pieces, soft or disintegrated stone, dirt or other objectionable matter. Stone shall have a per cent. of wear of not more than six (6). Slag shall be non-glassy in character and its weight per cubic foot when shaken to refusal shall be not less than seventy (70) pounds. The stone or slag shall meet the following graduation requirements:

	Per cent.
Coarse Stone:	
Pass in 3″ screen, not less than	100
Retained on a 1¼″ screen, not less than	85 to 100
Screenings:	
Passing a ¾″ screen, not less than	95 to 100
Total passing a ¼″ screen	40 to 80

Material Specifications.

Water.—The water used in mixing Portland Cement Concrete shall be reasonably clean and free from oil and organic matter. It shall not have an acid or alkaline reaction.

Fine Aggregate.—Fine aggregate shall consist of natural sand or screenings produced by crushing a coarse-grained sandstone or quartz pebble conglomerate, or a combination thereof, having clean, hard, strong, durable uncoated grains. When incorporated in the pavement mixture, fine aggregate shall be free from frost, frozen lumps, injurious amount of dust, mica, soft or flaky particles, shale, coal, alkali, organic matter, loam or other deleterious substances.

Grading.—The grading of the dry fine aggregate shall comply with the following requirements:

	Per cent.
Passing ⅜-inch laboratory screen	100
Passing ¼-inch laboratory screen	95 to 100
Passing 50-mesh sieve	5 to 25
Passing 100-mesh sieve, not more than	5
Weight removed by elutriation test, not more than	3

Coarse Aggregate.—The coarse aggregate shall consist of one of the following materials: crushed rock, washed gravel or air-cooled blast-furnace slag. In no case shall coarse aggregate containing lumps of frozen or partly cemented material be used.

Grading.—Coarse aggregate shall be uniformly graded within the limits shown in the following table, and any material which does not come within the limits specified shall be rejected:

	Per cent.
Passing 3-inch screen	100
Passing 2½-inch screen	95 to 100
Passing 1½-inch screen	40 to 75
Passing ½-inch screen	15 to 25
Passing ¼-inch screen	0 to 5

STATISTICS BASED ON ROAD MILEAGE.

In the First Annual Report of the State Road Bureau (as it was then called) issued in 1914, by A. Dennis Williams, Chief Road Engineer, a table was published as an insert opposite page 306 which gives some interesting statistics and calculations concerning all the counties of the State from which the following data on Hampshire and Hardy Counties are taken:

	Hampshire County.	Hardy County.
Miles of Road	950	500
Population, 1910	11,694	9,163
Number of Families	2,433	1,772
Number of Dwellings	2,401	1,742
Population per Square Mile	18	16
Population per Mile of Road	12	18
Number of Families per Mile of Road	2.6	3.5
Total Land Area in Acres	414,720	367,360
Farm Land, Area in Acreas	347,171	248,869
Improved Farm Land, Area in Acres	141,296	95,520
Total Number of Farms	1,699	1,106
Farms per Mile of Road	1.79	2.21
Area of Farm Land per Mile of Road	365.44	497.74
Area in Square Miles	648	574
Per cent. of County Mileage Against State Mileage	3.00	1.68
Per cent. of County Population to State Population	0.95	0.75
Per cent. of County Area in Acres to State Area	2.70	2.38
Number of Horses and Mules and Asses on Farms	4,302	3,266
Number of Horses and Mules and Asses not on Farms	209	103
Horses and Mules on Farms per Mile of Road	4.5	6.5
Horses and Mules not on Farms per Mile of Road	0.22	0.2
Orchard Fruits, Total Number of Trees	528,900	100,905
Orchard Fruits, Total Number of Bushels	154,965	27,697
Fruit Trees per Mile of Road	555	202
Number of Bushels per Mile of Road	163	55

Acres Cereals—Corn, Oats, Wheat, Buckwheat, Rye, Peas, Beans, Potatoes and Sweet Potatoes	30,933	22,270
Bushels Cereals	456,789	398,364
Acres—Hay and Forage Including Tobacco and Cane	11,066	8,535
Acres—Hay and Forage Including Tobacco, Straws and Fodder	40,341	38,358
Acres Cereals, etc., per Mile of Road	33	45
Bushels Cereals, etc., per Mile of Road	480	797
Acres Hay, Forage, etc., per Mile of Road	11.6	17.1
Tons Hay, Forage, etc., per Mile of Road	42.5	76.7

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